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CHARLES W. PRICE
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STEPHEN H. GODDARD
SECRETARY AND MANAGER
RUSSELL HOWLAND
GENERAL REPRESENTATIVE

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TO ADVERTISERS

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Monday noon to ensure publication in that week's issue.

An abstract of Mr. James Swinburne's recent lecture on "Electrolysis of Gas Mains" appears on other pages of this issue. Added weight is given to the lecturer's opinions by his position as president of the English Institution of Electrical Engineers. It is evident that the subject is receiving the attention of many bright minds.

It must be very exasperating to those users of coal who, in these days of expensive fuel, are spending time and money to avoid smoke, to see others utterly indifferent to the public comfort. There is one building, not far west of the New York Post Office, which is never seen without a banner of smoke trailing from its stack, while frequently it belches forth black clouds of which an Atlantic liner might well be proud.

THE GROUNDING OF DISTRIBUTING SYSTEMS.

The question of grounding one wire of the low-tension distributing systems is being energetically discussed, and with considerable diversity of opinion, in England. In regard to the three-wire system, this is chiefly urged on account of the lessened danger of shock from the full voltage.

Grounding one side of a two-wire system is suggested as a question of economy in construction, as this would permit the use of one bare conductor and save the cost of insulation. A further saving would arise from the decreased size of conduit necessary in the so-called solid underground systems, and it is suggested that when an iron conduit is employed this might be made the return conductor. It is claimed that electrical distribution labors under a disadvantage as compared with gas, as it is necessary to install two expensive conductors in addition to the conduit, while gas needs the pipe alone. It is thought that the saving which can be effected by using one bare wire will help considerably in overcoming this disadvantage.

A point urged against grounding is that electrolysis will be set up, not only of the bare conductor itself, but also of neighboring metallic bodies, due to leakage of the current. The actual effects of this, however, are somewhat in doubt. Another objection against grounding is that there would be greater liability of breakdowns, due to failure on the insulated side of the system.

In this country the underwriters allow grounding of only such wires as normally carry no current, with, however, the exception of the return circuit of the trolleys. The neutral of the three-wire system comes under this head, and it is also allowable to ground the centre of the low-tension side of transformers.

Judging from the difficulties met in obtaining these concessions, we doubt if the question of using a bare conductor for two-wire system distribution will be agitated in this country. It would be interesting, however, to see the plan tried somewhere. Our distributing systems are becoming more and more complicated, and the possible simplification which would result, in the lines and switchboards, from substituting one common return for half the wires which leave the station is worth a thought.

THE USE OF ELECTRICITY VS. COMPRESSED AIR.

The August number of *Compressed Air* tells an interesting little story of how the lives of six or eight men were saved, after an explosion of gas in a mine. The genius of the party, knowing that a compressed-air pipe passed through the section where the men were confined, groped his way to it, and, breaking one of the joints with a pick, supplied the necessary fresh air to keep all alive until they could be reached.

In conclusion, the editor says: "We would not be surprised to see legislation directed against the introduction of electricity within the mine. Air is exactly what is wanted in a heading, and electricity is just what is not wanted."

This attack seems rather uncalled for. It does not appear that electricity was the cause of this accident, nor even was used in the mine where the trouble occurred, while compressed air was used. Had electricity been used here there would have been no occasion for an open flame, and hence, in all probability, no explosion.

As to the second clause in the above quotation, this announcement comes a little late. The application of electricity to mining operations is growing at a rate which compares very favorably with other lines of electrical development. Evidently all mining engineers do not accept this dictum of the compressed air authority as final.

PRINCIPLES OF THE DYNAMO.

Few of us can watch a dynamo in operation without a feeling akin to awe, though the inspiration may arise from very different sources. To the layman it is little less than a miracle that the simple spinning of a mass of iron and copper between the poles of a large magnet should suffice to light his house, carry him from place to place and do all the countless things for which to-day electricity is operative agent.

To the engineer, however, this feeling comes from a different source. He knows and understands the accepted theory of the operation of the dynamo and is familiar with its construction. Hence it is the simplicity of the thing and the beauty of its operation that impress him. What other great tool have we that can be compared with the electric dynamo in this respect? Here is nothing but a cylinder built of iron discs and wound over with copper wire, having suitable contact provided for conducting the electric energy away after it is set in activity. Then this barrel of metal is placed within a powerful magnetic field, suitable driving force is provided, and we have a servant capable of executing our most exacting commands and doing this with a willingness and promptness that can not be rivaled.

The layman wonders because he does not understand; the engineer because of the simplicity of the machine, but of the action he knows just as little as the layman, for our theories merely give us something plausible to think about and of themselves prove nothing. Here is a generator with an armature sixteen and one-half inches in diameter and nine inches in length. The active surface is only three and one-quarter square feet, and yet we are told the output is fifty-six kilowatts or seventy-five horse-power. That is to say, this generator can do in one second the equivalent of lifting twenty tons one foot. How is this accomplished?

To gain a fair idea of the physical explanation, let us go back to the beginning, as far as 1819. In that year Oerstedt discovered the first connection between electricity and magnetism. He found that if a wire carrying an electric current from a battery—batteries in those days being the only source of electricity in quantity—was held in the neighborhood of a magnet, the magnet was affected and tended to set itself at right angles to the wire. This was a discovery of the greatest importance and led directly to the invention of the electromagnet.

But to the physicists of that day there was a deeper meaning. Here was established a connection between electricity and magnetism, and they set themselves earnestly to work studying and recording the various phenomena observed. There was, however, one master mind at that time to whom this electromagnetic action brought a larger thought. To Faraday came the idea of reversing this phenomenon and generating an electric current by a magnet. He recognized the general law of the reversibility of physical phenomena. Here was one which might by some means be reversed. Given a magnet, it ought to be possible to set up a current.

To-day nothing seems simpler to us than the method of doing this, but we must bear in mind the little that was known of physics at that time. It took Faraday, "prince of experimenters," as he has been called, until 1831 to discover the method. Simply it is this, Oerstedt's phenomena showed that a current flowing deflected a magnet. Faraday showed that if the magnet be moved in the neighborhood of the wire a current would be set up in the wire provided the circuit is closed. This fact represents the whole action of the dynamo. All that is necessary is relative motion between the magnet and the wire. Faraday's earlier apparatus differed in no essentials from the machine of to-day. A loop of wire, the ends terminating in slip rings, or even a two-part commutator upon which the collecting brushes rested, was revolved within a magnetic field.

To-day we usually wind the wire over an iron cylinder, but this is simply to increase the capacity of the machine, and for the same reason we use many loops in place of the one or two employed by Faraday. All the complicated and involved theories which we now study are simply tools to enable us to build knowingly, and to predict intelligently the behavior of our machines. We talk of magnetic flux and ether strain, cutting lines of force, but these are merely expressions we have manufactured to enable us to discuss the theories we have invented and bring us no nearer to the ultimate explanation of this action than were the physicists in Faraday's day. We know better how to build machines and how they will behave, but when we get down to hard facts we must confess our ignorance.

THE ELECTRIC FURNACE.

The importance, in many instances, of having energy available in convenient form is well illustrated by the ever increasing applications of the small electric furnace. Although the thermal efficiency of the electric furnace itself is high, the efficiency from coal pile to furnace is only about ten or twelve per cent. The thermal efficiency of a simple combustion furnace, on the other hand, is practically unity; that is to say, all the available energy of the coal is converted into heat. But here, due to the form of the furnace necessary, we meet with great difficulty in confining and controlling the liberated heat, much of it passing away in the escaping gases. On the contrary, in the electric furnace, the heat is easily confined and controlled, and can be applied just where it is needed.

In the combustion process we have a comparatively simple and inexpensive furnace in which the transformation of energy is direct, while in the electric method there are several intervening steps, each requiring expensive machinery. Thus, in addition to the low efficiency of the process, we must charge against it for the capital invested and for expenses of operation and maintenance.

Yet in spite of the cost and additional complications, the electric furnace seems destined to replace most of the older methods of producing high temperatures in the smaller operations. The single matter of convenience outweighs all other considerations.

THE ELECTROLYSIS OF GAS MAINS.*

BY JAMES SWINBURNE.

By far the greatest difficulty in a discussion of this subject is to give any real information as to the true effect of the earth currents from tramways. The question from the technical or scientific side is very obscure. If pipes are being corroded—even if the corrosion goes on to a very serious extent—it may not show for a long time. In fact, corrosion would only show when considerable damage had been done, unless a pipe company happened to examine a pipe which was specially strongly affected.

Electrolysis, or electric separation, applies to electric separation of chemical compounds. The most familiar example is electrolysis of water. If an electric current is caused in, say, acidulated water, the piece of metal which leads the electricity down is called the anode, or way down. The piece which leads the electricity up again is called the cathode, or way up. The two pieces of metal are called electrodes, or electric ways. The liquid is called the electrolyte, or thing that can be separated electrically. Water and solutions of salt are all electrolytes—that is to say, they are decomposed when there is an electric current, and a current can not exist between metallic electrodes in an electrolyte without decomposition. The decomposition is strictly proportional to the current and the time.

What we are concerned with is the corrosion of iron when used as an anode in the ground. In the ground in a town we may take it that the pipes are buried in earth or sand which is damp with salt, and other compounds of sodium, potassium and ammonium. The iron is thus attacked. If there is plenty of salt present we get chloride of iron, but the chances are that the iron is converted into basic salts or oxides. It does not matter much to the pipe what it is converted into. No harm is done to the pipe where it forms a cathode, as the only thing that could happen would be that metal might be deposited. Iron could not be deposited under the circumstances, so that we need only consider the corrosion of the anode. As the combining weight of iron is 28, the consumption of iron per ampere is 0.00029035 gramme per second, or twenty pounds a year.

It will be clear, then, that a gas pipe can only be corroded where it is acting as an anode—that is to say, where the electric current is leaving it, to pass into damp ground. There is no corrosion where the electricity enters the pipe, because it is a cathode there, and there is no corrosion where the electricity leaves, unless it passes into an electrolyte, such

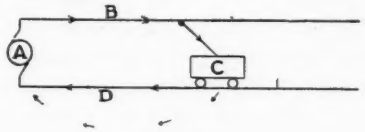


FIG. 1.

as damp earth. If the electricity is taken off by a metallic conductor, such as a wire (which is not an electrolyte), there is no corrosion.

We may now consider the electrical connections on a tramway system. In its simplest form a tramway system consists of an electrical generator driven by power at the station. This is connected with an overhead wire, which is thus kept at an electrical pressure of 500 volts. Each car has a trolley-wheel, which makes contact with the overhead wire, and connects to the motors. From the motors, the circuit is led to the wheels and thence to the rail. It is carried back to the station by the rails. The current that goes

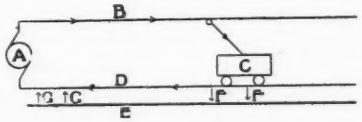


FIG. 2.

back to the generator is necessarily equal to the current that goes out. Electricity is not like gas; there is the return circuit which must carry the whole current. Any current that leaks away from the rails must either find its way back into the rails, or otherwise get back to the generator.

Whether the current will all go back by the rails, or will partly go by the earth depends upon the resistance of the paths. Iron, as a substance, has very little resistance compared with damp earth, but on the other hand the damp earth forms a very broad path—in other words, the

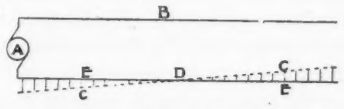


FIG. 3.

cross-section is very large. Again, the rails are not continuous, and the joints have more resistance than the rails. The result is that there is considerable straying from the rails. This is shown diagrammatically in Fig. 1.

Here A is the generator, B is the overhead system at 500 volts, C is a car, and D is the return circuit. Some electricity leaves the rails and returns toward the generator by the earth, and when it gets near the station it enters the rails again. The earth acts as a bye-pass. Electricians talk of leakage, but the analogy is the bye-pass. In Fig. 2 is another elementary system, with gas pipes shown close to the rails. The gas pipes are generally good conductors. Sometimes the joints do not make good electrical contact, and the resistance of the joints is high.

In Fig. 2, the gas pipe is shown at E. There is a current into the pipes at F, and out again at G. As has already been explained, the earth acts as a sort of bye-pass to D, and takes a share of the return current. The gas pipe acts as a sort of second bye-pass—that is to say, a bye-pass to a bye-pass, and there is thus a small current in the pipe.

If the system is examined it is seen that the rails have a fairly large current leaving them. The rails must be proportionately corroded at these regions. Then a portion of the leakage goes into the gas pipe at F. This does no harm as the pipes are cathode there. That is to say, the current into the metallic conductor does not corrode it. At G, however, the current leaves the pipe, so there is corrosion there. The electricity that leaves the pipe at G crosses through the earth to the rail, and thus to the generator. If, therefore, the pipe is connected by means of a wire to the return or negative end of the generator circuit, the electricity leaves the pipe by a metallic conduction, so that there is no corrosion. As will be seen presently, making metallic connection to the pipes in the neighborhood of the station is one of the methods of minimizing the electrolytic corrosion.

In the case of electrolysis there is often a back-pressure; for instance, when water is electrolyzed into oxygen and hydrogen. But in the sort of electrolysis which we are discussing, there is generally no appreciable back-pressure. This is mentioned because it is sometimes said that electrolysis can not take place unless there is over one volt of pressure available.

If we consider a track where the rails form the only return, if the current to be returned is large and the distance long, so that the resistance is considerable, we might have considerable pressure between the far end of the rails and the station. In America, especially in the early days, they had very high pressures on the rails—sometimes thirty volts and upward. Taking the earth itself generally as being

*Abstract of a paper read at the Southampton meeting of the Incorporated Gas Institute (British), June 11.

at zero pressure, or to use the water analogy, at zero level or head, we may consider that one end of the rails would, in the extreme case mentioned, be fifteen volts above the zero, and the other fifteen volts below. With such a pressure as this there would be considerable leakage, or bye-passage of current through the earth. Any pipes lying along the route would then pick up a portion of the stray current, and suffer corrosion where the electricity left it.

The variation of potential along the earthed return, supposing it to be uniform, is shown in Fig. 3. Here EE is the return, and its potential with regard to the earth is given by the vertical distance between EE and the inclined line CC. At the far end the rails are positive (this being shown by C being above E), and no corrosion of pipes will take place. But at the near end they are negative. Between these two areas there is a spot D where the rails are at earth potential, and there is no tendency for electricity to pass to or from the pipes.

We may now consider the precautions and measures taken to minimize corrosion of pipes. The first thing is to keep the resistance of the return rails as low as possible. The resistance is chiefly at the joints, and it is difficult to make good contact by means of the fish-plates. The rails are therefore "bonded," or electrically joined by bonds of flexible copper. Sometimes, in order to make better joints the rails are electrically welded, or welded and cast by Goldschmidt's process, or joined by pouring fused iron round them from a portable cup.

In a long line, or where the traffic, and therefore the return current, is large, no amount of bonding will do. The Board of Trade here comes in with a regulation that a tramway must not spend more than seven volts on its return rails. What are called "suckers" are therefore introduced. Fig. 4 shows the system with suckers. The suckers are insulated conductors, which draw off from various points of the system. They generally have what are called "negative boosters" in their circuits. A "booster" is a machine for adding a little pressure to a circuit; a negative booster subtracts pressure, or sucks. It is an electric motor, driving a generator; the generator being so arranged that it sucks in proportion to the current, so that the far end of the sucker, where it joins the rails, is kept at nearly zero pressure, or not more than 3½ volts below it. Thus, in Fig. 4 an insulated conductor C is taken from the point F of the rails through a negative booster D to the generating station. The potential of the rails is represented by the line GH IJ, which shows that some sections of the track are positive and some negative.

The rails are insulated to some extent (incidentally) by being embedded in concrete, which is a very bad conductor when dry, but according to many measurements conducts well when wet. It might be worth while to saturate it with some

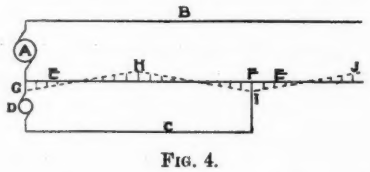


FIG. 4.

waxy, tarry or greasy material when quite dry. Tarring the rails or coating them does not insulate them permanently. A layer of asphalt keeps the ground under it dry, and so increases the resistance.

The Board of Trade regulations do more than limit the difference between different parts of the earthed system. They provide that, with earth plates at the station at least twenty yards apart, with not more than one ohm resistance to earth in parallel, these plates shall only collect two amperes per mile of tramway, or five per cent of the total current. Any rails must not be more than 4½ volts above any neighboring pipes or 1½ volts below them. These pressures are determined with Leclanche cells. They make various other minor regulations.

Sometimes, instead of using suckers, the flow of electricity is helped along the rails, as it were, by what we may call "helpers" or "helpers home." These are "boosters" arranged in the rail-circuits so as to help the flow, as it were. Thus, suppose the engineer decided to keep within a limit of four volts maximum

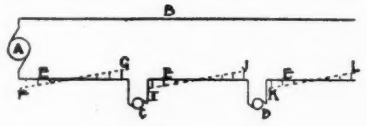


FIG. 5.

difference of pressure in his rails. At maximum load a length of rails might have four volts drop of pressure, from + 2 volts to — 2 volts; the middle being at zero or earth pressure. At the — 2 point the rail would be severed and the electric circuit led through a conductor to a booster, which would add four volts, and return it to the next section at + 2 volts. The system is shown in Fig. 5, in which C and D are the boosters inserted in the rail-circuit E. The potential of each of the sections varies from positive to negative, as shown by the inclined lines FG, IJ, and KL. Helpers are not used, as far as I know, but the idea, though old, has been recently revived.

Little or nothing more can be done to protect the pipes by dealing with the return-rail track. Something can, however, be done to the pipes. As has been explained, it is not the entry of the electricity into the pipes that does the harm; it is where the electricity leaves the metal and goes into the damp earth—that is to say, where the pipe is acting as anode. If all the parts of the pipe that might act as anode are connected by wires to the rails, or to the station, so that the electricity can be carried off without passing into an electrolyte, there is no electrolysis and the pipes are safe. The region round the station is clearly that where the pipes may be anodes. This region is therefore often known as the "danger area," and if metallic connection is made from the negative terminal of the station to the pipes in the danger area the pipes are safe. This increases the current in the pipes; but that does not matter to the pipes unless there are joints which cause the electricity to pass round by the earth. The increase of current means increase of corrosion of the train rails; but that is clearly the tramway people's lookout. When suckers are used they are arranged so that they reduce the pressure of the rails where they join below the earth, so that the rails are then negative to the earth. They therefore make local danger areas. The pipes should thus, where possible, be connected to the rails there.

The precautions in design and working which can be taken by the tramway engineers are thus:

(*a*) Good bonding of rails, and rails of large section.

(*b*) Suckers to the rails from the power-houses.

(*c*) Insulation of rails by concrete, and so on.

(*d*) Inserting "helpers" in the rail-circuits.

There is still another system which has not received the attention at the hands of electrical engineers that I would suggest it deserves—that is, the "three-wire" system. Along one line the overhead wire is at a pressure of 500 volts; along the other it is negative, at— 500 volts. The circuit is then not from the rails to the power-house, but merely across to the other rails and home by the next tram-car and the — 500-volt overhead wires. The system is more complicated, and there are 1,000 volts between neighboring overhead wires, as well as the usual 500 between one and the earth. There is also difficulty in balancing so that there is approximately the same current on each side. Connections from the rails to the power-house are still necessary, but they are smaller and much less numerous for a given area.

[*To be concluded.*]

LOUISIANA PURCHASE EXPOSITION.

SPECIAL RULES AND REGULATIONS PROVIDING FOR AN INTERNATIONAL JURY AND THE SYSTEM OF MAKING AWARDS, ETC.

The total number of jurors in the International Jury of Awards shall be approximately two percentum of the total number of exhibitors, but not in excess of that number, and each nation having fifty exhibitors or more shall be entitled to representation on the jury. The number of jurors for each art or industry and for each nationality represented shall, as far as practicable, be proportional to the number of exhibitors and the importance of the exhibits.

Each group jury shall be composed of jurors and alternates, the number of alternates in no case exceeding one-fourth of the number of jurors, and having a deliberative voice, and voting only when occupying the places of absent jurors.

The United States jurors and alternates of the group juries shall be nominated by the chiefs of departments to which the respective groups belong. The jurors and alternates of the group juries representing foreign countries and the United States insular possessions shall be nominated by the commissioners of such countries.

The chief of each department shall have general charge of the organization and direction of the group juries in his department, for the purpose of securing the proper examination of all exhibits, and to see that the work laid out for the juries is conducted strictly in accordance with the official rules and regulations. He shall be admitted to all sessions of these juries for the purpose of directing their attention to matters relating to the judging of exhibits. The work of the group juries shall begin thirty days after the opening of the exposition, and shall be completed on or before sixty days after the opening of the exposition. Examinations or other work not completed in the time specified will be transferred to the department jury.

Group juries may, on the recommendation of the chiefs of their respective departments, and with the approval of the director of exhibits, have authority to appoint as associates or experts one or more persons especially skilled in matters submitted for examination. These experts shall participate only in such special work as they are selected to perform, and shall have no vote on the question of the merit of the exhibit under consideration.

Each group jury shall carefully examine all exhibits pertaining to the group to which it has been assigned. It shall also consider and pass upon the merits of the collaborators who have been conspicuous in the design, development or construction of the exhibits.

The jury shall prepare separate lists showing exhibitors out of competition; awards to exhibitors in order of merit; awards to collaborators in order of merit; a report giving an account of the most important objects exhibited and a general account of the group as a whole. These papers shall be certified to the chief of department to which the group belongs, and within ten days after the receipt of said papers the chief of the department shall certify the same with such recommendations as he may deem advisable to the department jury.

The exhibits of persons occupying the position of jurors or alternates, and such exhibits as may have been specially exempted, shall be classed as non-competitive, and shall not be examined by the juries. This rule applies to managers, agents or others representing a company or corporation which is entered as an exhibitor. It does not, however, apply to the officers or representatives of governments that are entered as exhibitors. Provided, however, that any exhibitor may act as juror or alternate, without delinquency, in any group other than that in which his own exhibit is entered.

Each regular exhibitor may receive an award, although several exhibitors are combined in a single installation. Only one award shall be given to a collective exhibit, but the names of all the contributors to such collective exhibit may be entered on any diploma awarded and such participant shall receive a copy.

Whenever it is applicable a decimal scale system shall be used in judging the merits of exhibits, 100 representing perfection; and as a suggestion to juries, for instance in commercial exhibits, the following is offered:

(*a*) Value of the product, process, machine or device, as measured by its usefulness, its beneficial influence on mankind in its physical, mental, moral and educational aspects; counting not to exceed 25.

(*b*) Skill and ingenuity displayed in the invention, construction and application; counting not to exceed 25.

(*c*) Merits of the installation as to the ingenuity and taste displayed, the cost and the value as an exposition attraction; counting not to exceed 10.

(*d*) Magnitude of the business represented, as measured by the gross sales during the calendar year preceding the opening of the exposition; counting not to exceed 10.

(*e*) Quality or cheapness, with reference to the possession of by the exhibit of the highest possible quality, or the fact that the article is sold at so low a price with reference to its quality as to make it a valuable acquisition to the purchaser; counting not to exceed 10.

(*f*) For the completion of installation within required time and for excellence of maintenance; counting not to exceed 10.

(*g*) Length of time the exhibitor has been in business, as showing whether exhibit is a development of original invention or is an improvement on the work of some prior inventor; counting not to exceed 5.

(*h*) Number and character of awards received from former expositions; counting not to exceed 5.

A special award, consisting of a gold medal, in each department, may be recommended by the department jury for the best, most complete and most attractive installation.

The following scale of markings shall be used in determining the final merits of an exhibit and fixing the award that should be made, 100 being used as indicating perfection.

Exhibits receiving markings ranging from 60 to 74, inclusive—bronze medal.
Exhibits receiving markings ranging from 75 to 84, inclusive—silver medal.
Exhibits receiving markings ranging from 85 to 94, inclusive—gold medal.
Exhibits receiving markings ranging from 95 to 100, inclusive—grand prize.

The diplomas or certificates of award for exhibitors shall be signed by the president of the Louisiana Purchase Exposition Company, the president of the Louisiana Purchase Exposition Commission, the secretary of the Louisiana Purchase Exposition Company, the director of exhibits and the chief of the department to which the exhibit pertains.

Special commemorative medals and diplomas may be issued to the officers of the exposition, to United States, state and foreign commissioners, to the members of the International Jury of Awards, and to such other persons as may be deemed worthy of special recognition.

The compensation of foreign jurors shall be fixed and paid by the countries which they respectively represent.

United States jurors, except such as are officers and employés of the exposition, shall receive necessary and actual cost of transportation, and compensation at the rate of seven dollars ($7) per day for such time as they are actually engaged in the work assigned them at the exposition.

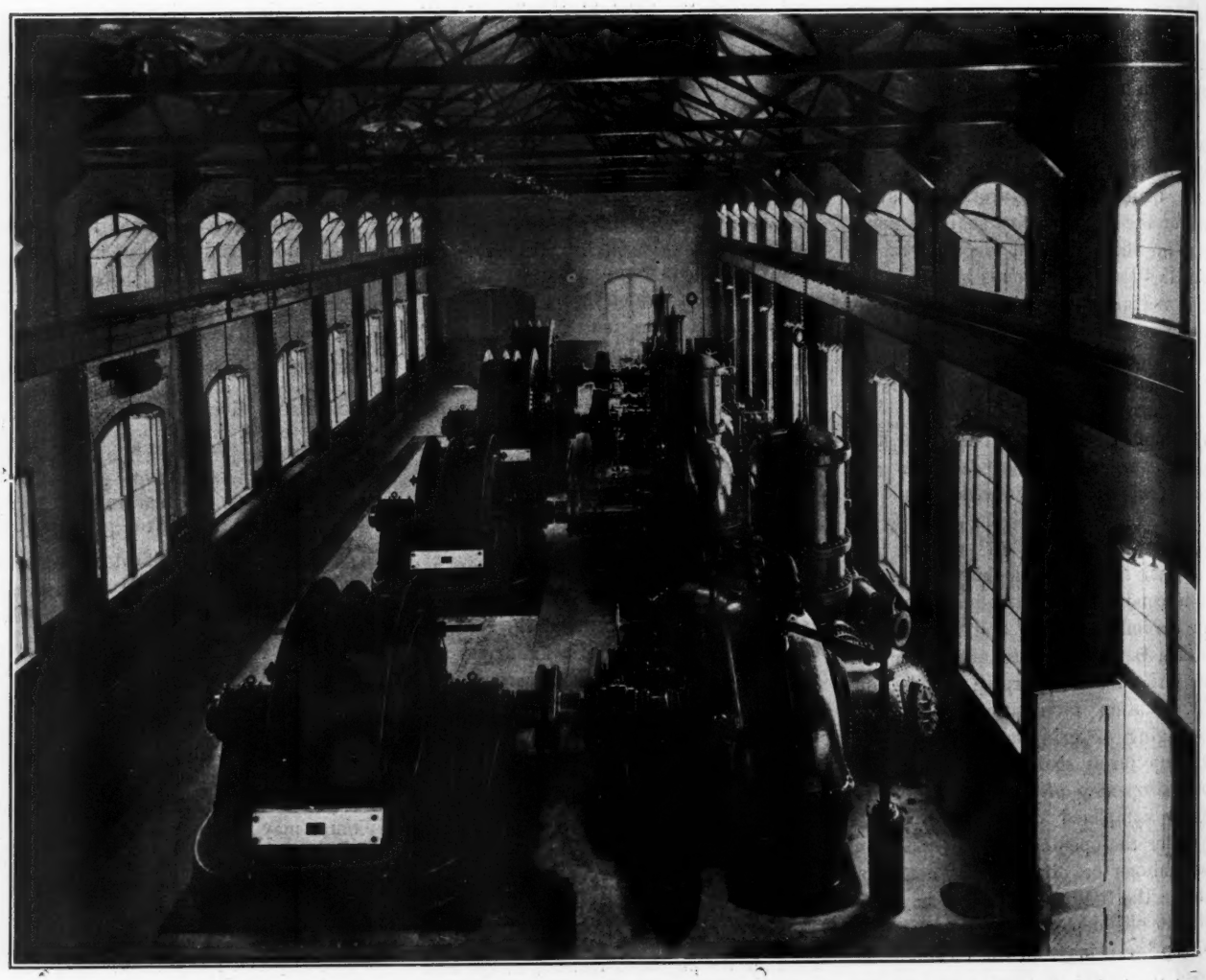
The Largest Electrical Transmission in Canada.

By Alton D. Adams.

NIAGARA is the site of the greatest development of electric power by water on the American continent, but a transmission longer than that from Niagara is in operation just across the river in Canada. Hamilton is the objective point of this Canadian transmission, and the entire electrical supply and traction systems there are operated by it. Lake Erie is the reservoir from which both systems draw their energy. Between Lake Erie and Ontario there is a difference of 325 feet in elevation and an inviting opportunity for the development of water power is presented at points other than Niagara Falls.

Such a point near a creek that flows into Lake Ontario, at the base of the Niagara escarpment and about five miles from the head back on the Welland canal, has been selected for the power-house of the Hamilton Electric Light and Cataract Power Company, Limited, of Hamilton, Canada. This company owns and operates a number of formerly independent electrical supply and street railway systems in the city of Hamilton. The power-house just mentioned receives water taken from the Welland canal at a point about ten feet below the Lake Erie level. This water enters a canal owned by the electric company and is conducted about five miles along the Lake Erie plateau through three storage receivers, and ends near the brow of the Niagara escarpment at a point not far from the power-house.

Between the canal and power-house extends a steel penstock approximately 1,000 feet long and eight feet in diameter. The power-house is a comparatively long and narrow brick building with concrete floor and steel truss roof, finished inside as one story, but high enough to admit a traveling crane over the generators. Water-wheels and generators take up the greater part of the floor space at this power-house, and are set with shafts at right angles to its length. In the remaining floor space are located the step-up transformers. Water comes down through the steel penstock under a head of 263 feet and enters four turbine wheels. Two of these wheels are Riva Monneret turbines rated at 3,000 horse-power each, and the other two are of the Stilwell-Bierce make, rated at 1,500 horse-power each.



THE GENERATING STATION, THE WHEELS AND GENERATORS OF THE HAMILTON ELECTRIC LIGHT AND CATARACT POWER COMPANY, HAMILTON, CANADA.

Only one turbine is mounted on a single shaft instead of the usual pair, and each

THE GENERATING STATION, SHOWING PENSTOCK, APPROXIMATELY 1,000 FEET LONG AND 8 FEET IN DIAMETER, HAMILTON ELECTRIC LIGHT AND CATARACT POWER COMPANY, HAMILTON, CANADA.

wheel is direct-connected to an electric generator. An alternator of 2,000 kilowatts capacity at 2,400 volts, three-phase and of sixty-six and two-thirds cycles, is connected by a flexible insulating coupling to each of the two larger turbines, and a similar alternator of 1,000 kilowatts is connected in like manner to each smaller turbine. All four of these alternators were made by the Stanley Electric Manufacturing Company. Current from these four generators passes directly to the switchboard and thence to a bank of step-up transformers on the same floor. Ten

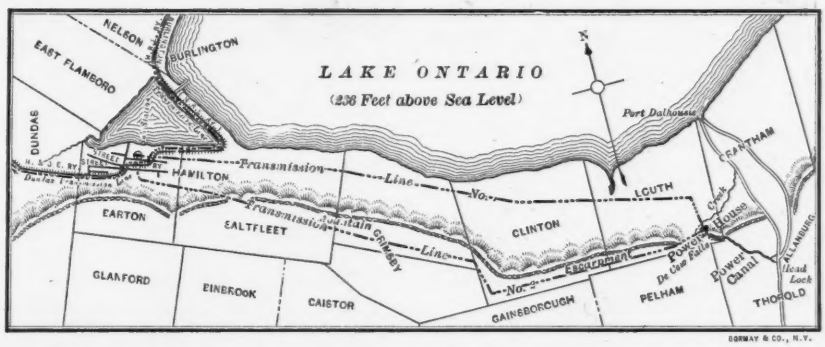
INTERIOR OF THE JAMES STREET STATION, 750 KILOWATTS CAPACITY, HAMILTON ELECTRIC LIGHT AND CATARACT POWER COMPANY, HAMILTON, CANADA.

transformers of 400 kilowatts each and ten of 200 kilowatts each make up this bank, and all change the three-phase energy from 2,400 volts primary to 22,500 volts secondary. All of these transformers are oil insulated and water cooled. Generators and transformers alike have thus a total capacity of 6,000 kilowatts at the water-power plant. One transmission line takes a direct route between the Niagara escarpment and the shore of Lake Ontario from the power-house to the substation in Hamilton, and has a length of thirty-five miles. The other line mounts from the power-house to the Lake Erie plateau, which it follows most of its length of thirty-seven miles to the same substation entered by the shorter line.

The poles for each of these transmission lines are spaced ninety feet apart. On one line glass insulators and on the other line porcelain insulators are employed. Each line consists of three copper conductors. On the thirty-five-mile line the conductors are arranged in a single plane, but on the thirty-seven-mile line the conductors form the corners of an equilateral triangle, each side being two feet long.

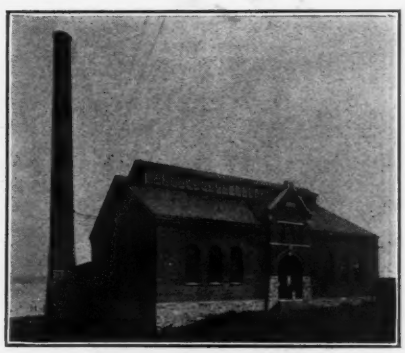
These two lines in quite different locations obviously add much to the security of the transmission.

The substation at Hamilton is a large brick building and contains, besides the



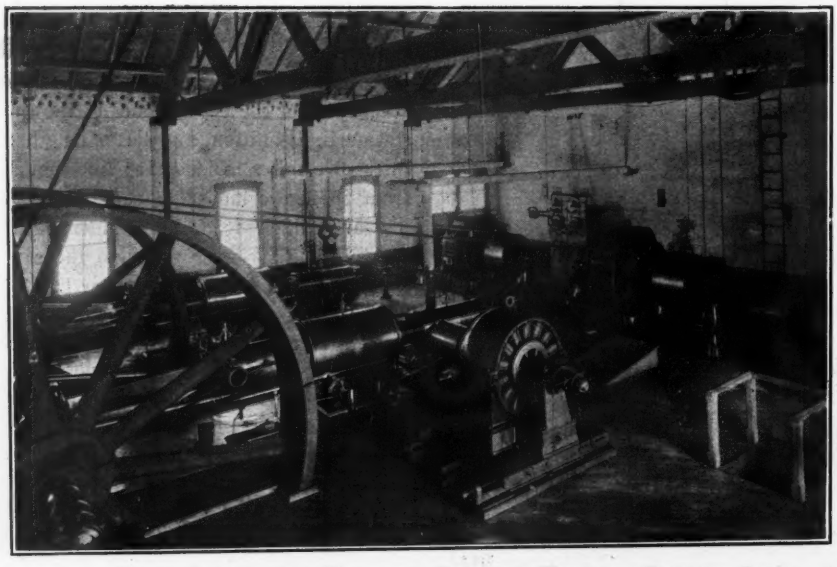
MAP SHOWING STATIONS AND COURSE OF TRANSMISSION LINE, HAMILTON ELECTRIC LIGHT AND CATARACT POWER COMPANY, HAMILTON, CANADA.

necessary bank of step-down transformers, rotary converters, a booster for the street railway, a large storage battery and dis-



EXTERIOR OF THE JAMES STREET STATION, HAMILTON ELECTRIC LIGHT AND CATARACT POWER COMPANY, HAMILTON, CANADA.

tribution boards for the lighting, stationary motor and traction circuits. Transformers at the substation have an aggre-



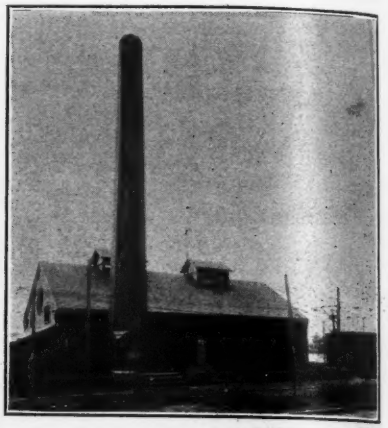
INTERIOR OF BEACH STATION, 500 KILOWATTS CAPACITY, HAMILTON ELECTRIC LIGHT AND CATARACT POWER COMPANY, HAMILTON, CANADA.

gate capacity equal to that of the bank at the power-house and change the transmitted energy from 22,500 volts, three-phase, to 2,400 volts, two-phase, for light and power work. A part of the transmitted energy is transformed at the substation for three rotary converters that deliver direct current at 550 volts for the street railway system. These converters are of 300 kilowatts capacity each and were made by the Westinghouse company. In conjunction with the rotary converters a storage battery of 400 amperes capacity, made up of chloride accumulators, is in use. Current is also transformed on the Manhattan system for use in city street lamps.

A synchronous motor of 250 kilowatts is employed to drive a 200-kilowatt direct-current generator of Canadian General Electric make that operates a 220-volt circuit for small motors. A simple steam engine of 500 horse-power is provided to operate this 220-volt motor system in case the transmitted power should fail.

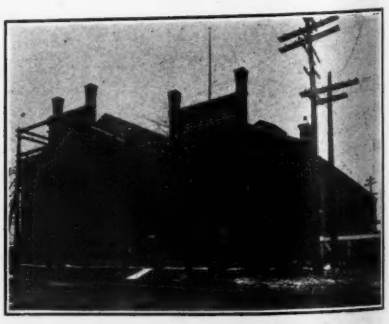
STEPDOWN TRANSFORMERS AT SUBSTATION, HAMILTON ELECTRIC LIGHT AND CATARACT POWER COMPANY, HAMILTON, CANADA.

Besides the equipment operated by water power the company uses steam to drive the equipments in two small stations at Hamilton, both of which are devoted to direct current at 550 volts for street railway work. One of these steam stations contains generators of 400 kilowatts, and the other generators of 600 kilowatts capacity, and the engines at both stations are tandem-compound and are operated condensing. Contracts have been let for an auxiliary steam equipment to be located close to the substation. The generators



EXTERIOR OF THE BEACH STATION, HAMILTON ELECTRIC LIGHT AND CATARACT POWER COMPANY, HAMILTON, CANADA.

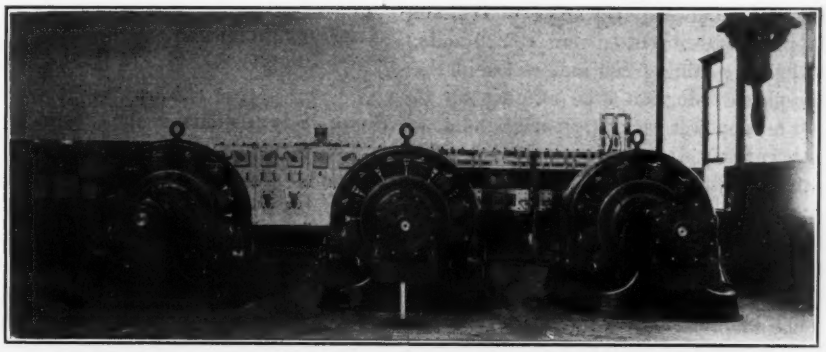
STORAGE BATTERIES AT SUBSTATION, HAMILTON ELECTRIC LIGHT AND CATARACT POWER COMPANY, HAMILTON, CANADA.



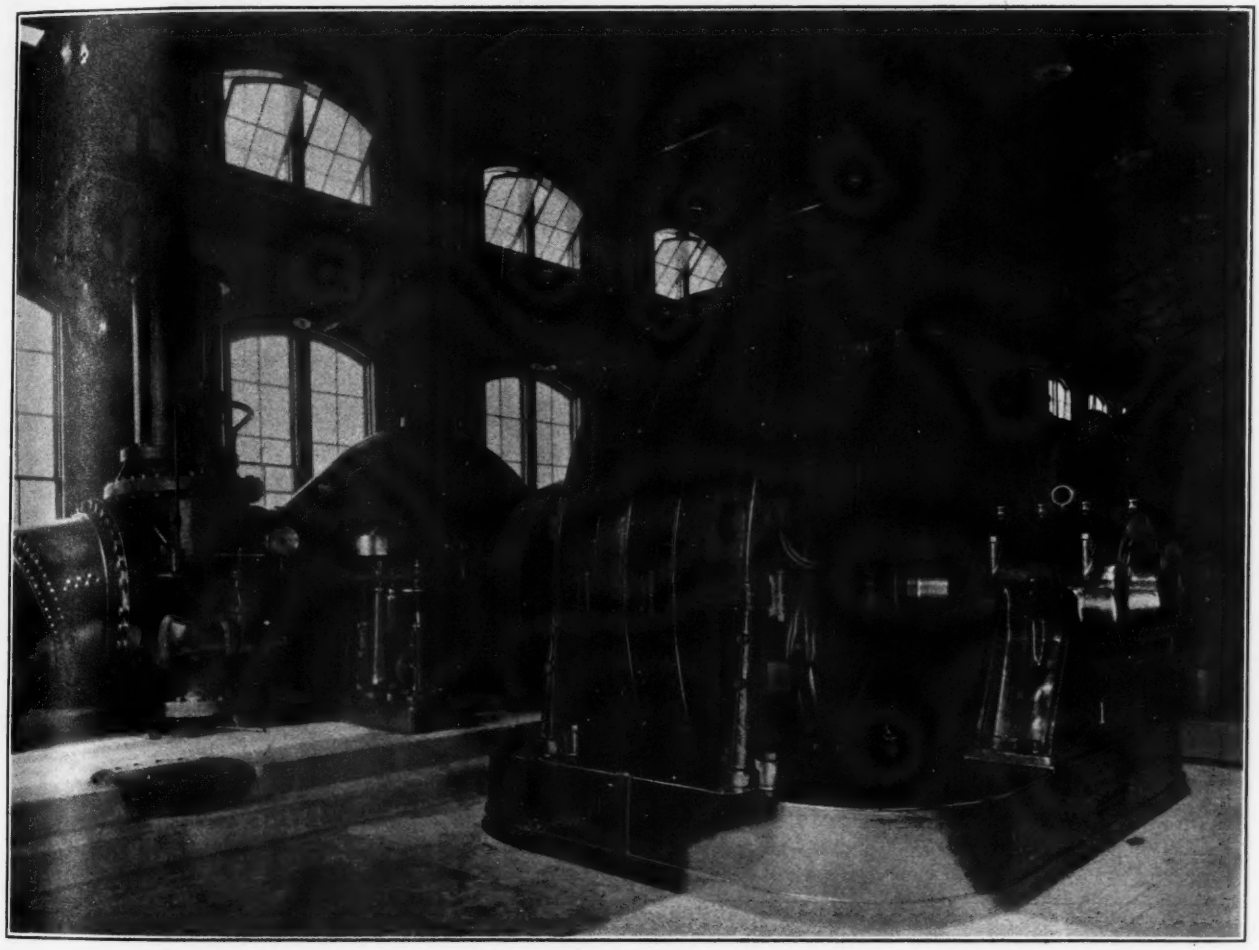
SUBSTATION, HAMILTON ELECTRIC LIGHT AND CATARACT POWER COMPANY, HAMILTON, CANADA.

for this steam auxiliary are 2,000 kilowatts capacity, made by the Westinghouse company, and will be driven by cross-compound engines working condensing with the steam at 165 pounds and at 100 revolutions per minute. Boilers for this plant are to be water tube and fitted for mechanical draft.

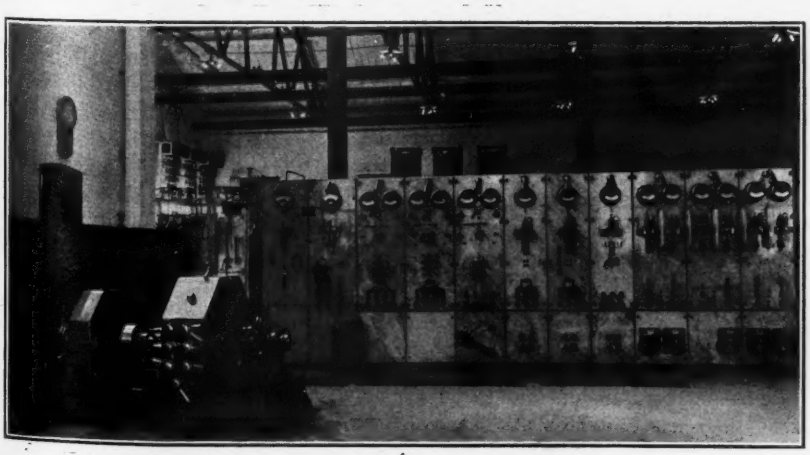
The generating equipments described operate the entire electrical supply and street railway systems of Hamilton, including a further transmission of some seven miles to Dundas, and a suburban railway to Burlington, about eleven miles away. Fifty-four miles of single track are included in the entire street railway system.



ROTARIES OPERATING AT 300 KILOWATTS EACH AT THE SUBSTATION.



2,000 KILOWATTS, 66⅔ CYCLES, 2,400 VOLTS, TWO-PHASE GENERATING SET.



THE RAILROAD SWITCHBOARD AND BOOSTER AT SUBSTATION.

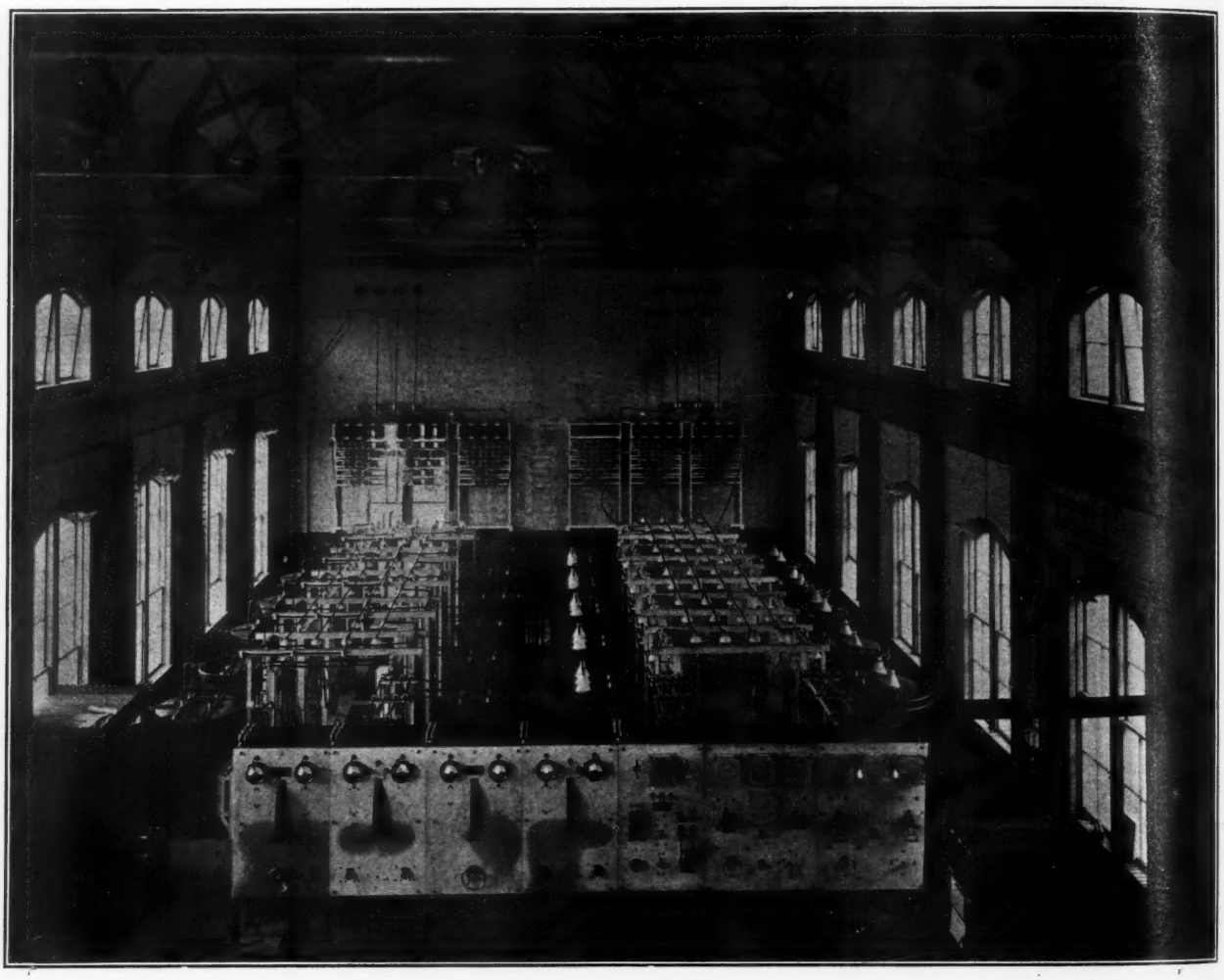
Enclosed arc lamps to the number of 575 are operated with alternating current, and 420 arcs are used to light the city streets. Approximately 55,000 sixteen-candle-power incandescent lamps are connected to the supply lines. Stationary motors form an important part of the connected load at Hamilton. The entire number of motors supplied is about 380, with a total rating of approximately 5,700 horse-power, or fifteen horse-power per motor on an average. The smaller sizes

of these motors, numbering about 180, are supplied with direct current at 220 volts, and the remaining 200 motors are of the two-phase induction type ranging up to 100 horse-power each in capacity.

At present the maximum load on the combined lighting, stationary motor and traction systems is about 4,800 kilowatts, or somewhat less than the capacity of the water-power station. Of this capacity the stationary motors alone require about 1,300 kilowatts. The nominal rate for electric lighting at Hamilton is fifteen cents per kilowatt-hour.

Changes for service to stationary motors are subject to wide variations according to capacity and time of use, the range being from as much as six cents down to one-half cent per kilowatt-hour. Water power has been an important element in the development of this large electric system in the face of competition by gas at $1 per 1,000 cubic feet. It may well be questioned whether equal results could have been attained with a steam-driven electric plant.

Thanks are due to Mr. William C. Hawkins, the general manager of this successful system, for the facts here set out.



THE GENERATING STATION, THE STEP-UP TRANSFORMERS, HAMILTON ELECTRIC LIGHT AND CATARACT POWER COMPANY, HAMILTON, CANADA.

Some Suggestions with Regard to Electric Motor Installations.

Trouble and dissatisfaction with electrical installations can frequently be traced to improper selection of apparatus and should not be charged against the system. Mr. A. H. Mayes, in a recent paper, discusses the various apparatus and their suitability for various conditions in this connection. The direct-current motor is first taken up. In many cases the partially enclosed or ventilated motor could be used in place of the enclosed type with an increase in the efficiency of twenty per cent due to the lower running temperature. It is always important that the brushes and commutator be easily accessible, and where the motor is enclosed large doors with mica windows should be provided to enable the attendant to detect sparking. Suitable enclosed motors are to be had when their use is desirable. The accessories are a more frequent source of trouble than the motor itself. The starting switch should be substantial. The starting rheostat should not allow more than full-load current to flow with the switch-handle on the first notch. Where a motor takes more than fifty amperes, it is well to limit the current to this on the first notch and not allow the rise for any succeeding notch to exceed this amount. This will avoid excessive shocks to the motor and prevent annoying fluctuations of the voltage of the system. The carrying capacity of the starting resistance should be ample as repeated heatings rapidly destroy it. The starting switch should always have an automatic release for no voltage. Fuses are recommended in addition to the circuit-breakers, the capacity of the fuse being twenty per cent greater than the current for which the circuit-breaker is set to open, and all fuses kept under lock and key to prevent tampering by the operator. Each motor should be provided with a main switch which entirely cuts off the current from the motor when opened.

DEPRECIATION IN TELEPHONE PROPERTY—IV.

A SERIES OF PAPERS ON AN IMPORTANT TELEPHONE PROBLEM.

BY FRED DE LAND.

Our fifth phase of depreciation is in the loss that is the result of the unexpected and the destructive effects of storms of wind, sleet and snow that no amount of engineering skill or of constructive ability can provide against unless all lines are placed underground. Yet, to place all the telephone circuits in a city in a subway system would necessitate an investment so great that the interest charge of six per cent on that investment would nearly equal the maximum Bell rate in the larger cities. Hence, pole lines and aerial construction will continue to be the practice for some years to come, even though the wild wind plays havoc with both. Some saving could be effected in building far heavier toll lines in sections of country where a solid yet extremely cumbersome structure would be tolerated. But the cost of such lines would be almost prohibitory. Even the present high standard of construction adopted by the long-distance companies is too costly for many independent companies to adopt, where the traffic passing over the lines yields but little increase in revenue.

As a writer in the *Telephone Magazine* says: "It is a comparatively easy matter for any one of ordinary intelligence to design a pole line that will be strong enough to resist all strains to which it shall be subjected, but it is the peculiar province of the engineer to design the pole line that shall be strong enough to withstand the maximum strain to be imposed upon it with a reasonable margin of safety. It is this line that costs the least to construct and maintain, and such lines it is the aim of all operating companies to build, and for this purpose engineers have come into being. Nor is it a simple problem to lay out one pole line and adapt it to all conditions. In southern territories, where gales are frequent, sleet and ice are scarce; in western territories storms of different natures prevail, such as the sand-storms on the prairies which prove so disastrous to poles exposed to their fury, while in the East and the North the greatest enemy to this kind of construction is the sleet-storm, so familiar in New England, though not unknown in New York and vicinity. Nor is the sleet-storm so harmful in itself as when it is immediately succeeded by a gale of some severity, which is the usual order of things as observed by the writer."

Every year since 1879 the daily papers have chronicled the ravages of storms of wind and sleet and snow among telephone properties, and the blizzards and sleet-storms of 1888 and 1890 have become as historic in New York and New England as the "big storms" of 1895-96 and of 1900 are in St. Louis. Of course a heavy gale of wind or a storm of sleet may sweep over a wide area and affect only a small proportion of the total number of telephone companies. But never a gale blows destructively on land but some telephone company suffers more or less damage. And once or twice each year the press tells how some telephone company was damaged to an extent of thousands of dollars. The New York papers in giving the details of a gale of sleet and snow that raged along the Atlantic Coast this spring stated that "the New York & New Jersey Telephone Company lost, as the result of this one day's storm, poles and wires and cables that will require an expenditure of not less than $275,000 to replace, and probably $300,000, to say nothing of the loss in daily revenue." Then the Philadelphia papers in recounting the disastrous effects of the same destructive gale told how five telephone companies operating in Pennsylvania, Delaware and southern New Jersey "were damaged to the extent of more than $300,000." An earlier storm in February carried down "half the poles in Lexington, Ky., and surrounding country with loss estimated at $50,000." Going back two or three years we learn that "within a year after its pole lines were built the Detroit Telephone Company suffered a great deal of damage from a sleet and wind-storm. It cost us a little over $10,000 to repair this damage."

The Kinlock Company, in St. Louis, reported "a sleet-storm that cost us exactly $18,000," and the manager of the independent exchange in Chagrin Falls stated that "the only interruption to the service came in 1900 when a heavy sleet-storm blew down seven of the seventy-foot poles carrying over 100 wires, which put the company out of business for a short time, during which time it took occasion to move the office to the centre of the town." Then there was the account of the complete destruction of all the lines of the independent company in Coshocton, Ohio, and of a similar case in Kirksville, Mo.

The executive committee of the Milwaukee Telephone Users' Association in estimating the yearly depreciation in a Bell telephone plant states that this estimate "makes no allowance for damage cases of many classes, sleet, wind, storms, and other calamities which may affect the plant. To cover this, an additional one and seven-tenths per cent is added. . . . As an illustration of the loss beyond the ordinary wear and tear, it may be stated that two years ago, by reason of a sleet-storm, damage was done to the plant of this company to the amount of $12,000 within the space of thirty minutes, and that within the last past two or three weeks the Chicago Telephone Company has sustained a loss of $35,000 from the same cause." And storm testimony shows that as the result of a destructive gale in Washington, in September, 1896, "in some cases the pole lines were entirely down, and the total cost of replacing what was destroyed was between $15,000 and $16,000, or between $7 and $7.50 for each subscriber we then had connected with the Washington exchange."

And the city electrician of the city of Chicago states that "after the heavy sleet-storm of last March (1901), which broke down miles of pole lines, seventy-five miles of wire were required to repair the damage, this being one of the largest items in the cost of maintaining the fire-alarm system during the year." To show that Chicago is rapidly forcing the wires underground, it may be added that the report of City Electrician Ellicott for the year 1900 shows that "the removal of poles and wires from the thirty-two and one-half miles of streets represents an expense to the companies of over $400,000, and is a very creditable indication of their efforts to keep pace with the permanent improvements of the city." Incidentally it may be added that the Chicago Telephone Company removed its poles from over eighteen miles of streets during that period, so that over one-half of the expense mentioned—"over $400,000"—was borne by the telephone company.

And Mr. Frances W. Jones has told how severely telegraph companies suffer from destructive storms, how "on the south side of the Ohio River, below Louisville, for about fifty miles a telephone line was entirely wiped out of existence and had to be rebuilt," and of "the shattering of poles and the melting of wires by lightning, which has many times destroyed them, even with earth wires upon the poles."

The total earnings in one month may not be sufficient to renew and repair broken poles and wires. But the entire cost could be paid for out of a fund receiving its regular contribution from the

monthly earnings and held in reserve for just such contingencies. Certain Bell companies have such a fund styled "reserved for extraordinary maintenance," and regularly pay a portion of the gross earnings into that fund, and independents might wisely improve upon or at least follow that plan. But is the income of the average independent company sufficient to permit of a reserve fund?

The foregoing five divisions cover the ordinary phases of depreciation, as this subject is usually considered, and may be called the direct factors to the diminishing life of telephone property. And while these five phases are inseparably associated with the financial success of a telephone plant, there are other phases of depreciation of diminishing value that just as surely tend to lessen the earning power of an independent exchange as "wear and tear" or "improvements in the art" or "the destructive effects of storms," and that singly or collectively may make or mar the financial success of the best planned and most promising of independent exchanges.

For instance, there is: First—The lessening in value and diminished earning power, or depreciation that follows the agitation incident to the discussion of public-ownership movements, discussions that rarely lead to wise action, yet that tend to retard the normal healthy growth of an independent telephone system. The harm comes in the form of refusals to contract for the local service until the question of the municipality owning its own exchange is definitely settled. These discussions hurt the independent exchange far more than they do the Bell. For the people realize that while the municipality will naturally give a lower rate than the independents and let the taxpayers make good the deficit, its service must necessarily be limited to the confines of the city unless private capital builds the toll lines necessary to connect that city with the adjoining towns.

Municipal systems are now being advocated in Evansville, Detroit, San Francisco and a few other places. The committee having in charge the question of the advisability of the city of Detroit issuing bonds to construct and operate a telephone system, reported that "in the case of a municipal telephone system, all the taxpayers would assume the total liability of the expense of the telephone system for the benefit of the comparatively few telephone subscribers and users. In the case of an annual deficit, which would not be improbable, the taxpayers would again be called upon to pay the same, thus making the people who do not use telephones pay a part of the expense for those who do, all of which is legislation in the interest of the few at the expense of the many. Again, the municipal telephone system could be operated only within the limits of the city of Detroit and would have no connection with lines outside of the city, which would be a serious drawback."

The daily papers state that in San Francisco "a municipal telephone system completely under control of the city government, open to the public and in competition with the existing private telephone companies, is being projected at an estimated cost of $2,434,672, based on the proposition that the system shall start work with 25,000 individual telephone users, and with a capacity to accommodate 43,000."

From the daily press we learn that in Evansville, Ind., "the sentiment in favor of municipal ownership is sufficiently strong here to culminate in a scheme to install a municipal telephone plant to cost $250,000. The scheme originated with the mayor, city attorney and members of the board of works, who propose to organize a company to operate a new plant to be installed by issuing $200,000 of preferred stock, to draw three and one-half per cent, payable semi-annually. The city is to receive $250,000 of common stock in consideration of a franchise, the interest on said stock and other profits to be used in retiring the preferred stock and thus in time the city will own the plant. Subscriptions are now being taken for the preferred stock and a wave of sentiment for municipal ownership is sweeping over the city." And an advocate of the municipal plan says: "The cost of telephone construction and service is being outrageously misstated, and the installation of an up-to-date exchange, with the wires in conduits, would not approach the cost as given by alleged experts who, if they know anything, know better. The cost of superintendence would be nothing if added to the present duties of the city electrician, who would not even then be overworked. The city building would afford ample room for the exchange without the construction of a building, and connection with outside lines could be had, even if legislation was necessary to compel it."

In this connection, let me invite the attention of your readers to some extracts from a comprehensive and able paper which Mr. James B. Cahoon read before the National Electric Light Association at the Chicago meeting in 1900. The title of the paper is "Uniform Accounting," and was written because, while an honored participant in the proceedings of the League of American Municipalities at the Syracuse meeting, in 1899, he was startled by the "strong feeling shown in behalf of municipal ownership," and because "every one of the thousand members under their lack of system of accounting were fully convinced of the idea that by the city operating its own plant they could do it from twenty-five to fifty per cent cheaper than the same thing could be furnished by a private ownership." So he told the members of the Electric Light Association:

I doubt if there are in this whole association a dozen members who realize fully the gravity of the present situation for the private ownership of public utilities, and he clearly showed that, for their own protection, the electric light companies must adopt a uniform system of accounting containing all the factors entering into the true cost of production, and thereby show to the advocates of municipal ownership that to get the true costs they must follow our system. . . . Our plan of defence must lie in the correct determination of costs, and in showing that while we are exercising the functions of a monopoly we are only attempting to realize therefrom a legitimate profit for the capital we have invested in the enterprise. To do this we must have uniformity of accounting in order that we may present a solid front and be able to disarm the agitators by showing to the people at large that we are following fair business methods and only obtaining a fair return on our investment.

We are operating public utilities, and the public is going to demand, and is demanding at the present time, to know what it costs us to deliver our products to the consumer and what our profits are. Certainly, a part of our cost is taxes and, again, before we can declare a dividend we must take care of the interest on our bonds, and also on our current liabilities. In regard to investment insurance, or depreciation, as it is often termed, this is truly a factor of cost. Every plant undergoes depreciation from year to year, and in order that the value of the plant may not be depreciated, certain renewals must be made, and minor extensions or betterments added . . . a certain depreciation, determined on by experience, varying according to location and according to class of manufacture, we find, will occur every year. Let us take, then, the yearly proportion on the basis of lasting so many years and place it each year under the head of investment insurance, and use that in our business for minor extensions or betterments and renewals sufficient to keep our plant intact and in as good operating conditions as when first purchased, or, in other words, maintain our plant in such a manner that if a question of being compelled to sell it comes up we can show that we have maintained it in such a way

that the original investment is not impaired in the slightest.'

At the last convention of the International Association of Municipal Electricians, Captain William Brophy said:

Municipal ownership of underground conduits for electric wires and cables is the last and, perhaps, the most important subject to be discussed. The question of municipal ownership has taken a wonderful hold of the mind of the people of some parts of this country. In many sections in the past it has amounted to a craze, and even to-day, with many sections of the country strewn with municipal ventures that have proved disastrous failures, municipal ownership still has many friends and advocates. A monopoly is looked upon with disfavor by the great majority of mankind. But few are found to defend it; it is a fruitful theme of discussion for all classes. Competition, on the other hand, is almost universally encouraged by the public, particularly when it expects to profit thereby. If healthy and honest competition is encouraged by municipal ownership of underground conduits it may result in a benefit to the community. But when, as in nine cases out of ten, competition is only a scheme by which an established industry is forced to buy out an unscrupulous rival, leaving on the hands of the municipality a system of conduits constructed for the encouragement of competition from which no rental can ever be derived, and in addition to the interest charges on the unused conduit system, then interest on the unnecessary amount of capital used in the purchase of a "fake" competitor must be paid by the public, it can not be said that it is greatly benefited by the encouragement of competition. This applies with equal force to the claim that a large profit will be secured to a city owning and renting a system of underground conduits, but other reasons can be urged against such ownership. Under the present system of municipal government, for which the unenviable distinction of being the worst in the world is often claimed for it, no public work can be undertaken and completed by a city as cheaply and well as can be done by private enterprise, so that it can safely be said that the rental charged for the use of a system of conduits constructed by any city would have to be far in excess of that charged for similar ones built by private enterprise; there may be exceptions to this rule among the smaller cities, but if they are, they are few and far between.

And Mr. E. F. Schurig, city electrician of the city of Omaha, Neb., has publicly stated that—

The history of municipal ownership, in so far as the electrical industries are concerned, is such as not to commend itself very strongly. In almost every instance where the municipality has installed a public lighting plant figures are manipulated, and the true cost of the product is never charged against the plant. Political management of public-service industries under present conditions can not obtain that degree of efficiency and economy which is necessary to compete successfully with private management, for the reason that political preferment in the transaction of municipal affairs and in filling positions will not be eliminated. The only apparent benefit to be derived from the ownership of conduits by the municipality is the control of the streets. This can be gained by simpler arrangements without incurring a large initial expenditure by requiring the electrical companies to build their own conduits in accordance with suitable conditions to be imposed by law.

At the recent annual meeting of the Independent Telephone Association of Wisconsin, Judge Gaynor said: "I admit that the telephone is the most perfect type of what is usually classed by economists as a natural monopoly and that a perfect or ideal system for this service would put it under a single management. But until our laws are modified so as to permit public ownership or public control of the utilities competition is the only source of protection left to the people. Natural monopolies under private ownership are frequently manipulated so as to fleece the public. The evils resulting from private ownership of such industries are often so flagrant and unbearable that laws have been passed and franchises found to secure protection and relief, and all without much success." And the judge might have added that "the evils resulting from" municipal control have also become unbearable. But that is another story. The relief lies not in municipal ownership, but along the lines so ably advocated by the editor of *Public Policy*, which may be summed up as follows: "There is but one correct way to deal with a monopoly. It should be capitalized on the basis of a *bona fide* investment, its accounts should be kept as public accounts, so the people may know the truth as to all elements of cost; charges for service rendered should be determined on the basis of cost plus a reasonable profit, and benefits should go to the people by means of low charges rather than high taxes." And Mr. Henry C. Adams, statistician of the Interstate Commerce Commission, says: "It is impossible to overestimate the importance of a regularly prescribed system of accounts and of holding every accounting officer responsible for the integrity of his books under the code prescribed."

There is a sixth phase of depreciation that to many may appear to be an indirect rather than a direct force in lessening the value of telephone property. Yet, strange as it may appear, this phase has wrought more damage and created greater havoc in unsettling values than any other of the phases we have mentioned. This sixth phase is the loss that follows from seemingly unavoidable friction with new and old independent companies in neighboring towns, resulting in destructive rate cutting, in absence of cooperation, in inability to float bonds, in sowing seeds of distrust, and in delaying or preventing the united action that would lead to the adoption of a standardized method of construction and equipment, of uniform rates and of an equitable interchange of service. This phase is an actual condition and not a theory, as is shown in the following statements by independent leaders: Mr. R. F. Johnson told the members of the Independent Telephone Association of Michigan that "at the meeting of the National Association in Cleveland nearly two years ago, one of the brightest men in the telephone movement, in the course of his remarks, made the statement that 'there is no business in the world where each factor in the business is so dependent upon the success of each and every other factor in the same business as in the independent telephone business.' That remark was strictly true at that time, and its force has grown upon me since. Presuming that you all agree with me that this principle is true, the question arises in my mind, 'Are we transacting our business as though this was the true principle or are we acting in a great many cases directly to the contrary?'"

President George N. Bandy told the members of the Iowa Independent Telephone Association that "the great trouble with the independent companies is their disposition to regard their neighbors with suspicion." And Dr. Herr told them that "the independent companies are everywhere and still coming. They form a gigantic family, with many children of monstrous growth, who have not yet learned to walk steadily. Many have died since their birth; some died a-borning." And Dr. Herr concluded that "what the independent people most need is unity of action—but they have not yet learned how to unite their business on a basis of mutual profit." Then Mr. E. C. Holdoegel commented on "the danger from competing independent toll lines and disagreements as to the division of toll line fees to competing points," and also on "the danger which is becoming imminent in the building of cooperative or farmers' lines paralleling the toll lines of the independent companies, and the desire to connect these lines with the local exchanges and the toll line system."

Electrotechnical Industry in Russia.

Until recent times the electric industry has made extremely slow progress in Russia. Unfavorable circumstances have combined to impede the industry and prevent it from reaching the level found in other countries. One of the principal causes of this lack of development was the absence of schools in which to educate electricians. Foreign engineers and specialists prefer to have recourse to materials and apparatus made abroad, of which they know the value, rather than to try to build factories and works in Russia for the production of the articles required by them. Of late, however, the government, private companies and individuals have opened special schools for electricians; and, in addition, the special art and artisan schools have introduced an electrotechnical course. The influence of these special schools and courses has not been slow to make itself felt, and of recent years electric industry has made immense progress. Many towns and cities are lighted by electricity, and electric tramways are numerous. Nearly all of the large factories and industrial establishments have adopted electric lighting, and have applied electricity to the distribution of motive power. Electric energy has also been utilized in mining enterprises, particularly in the south of Russia. The use of electricity in soldering, in the extraction and refining of metals, as well as in certain electrochemical works, and in the production of carbons and hypochlorites, is now well developed in Russia. With the increased and varied applications, the demand for apparatus has grown enormously, and dynamo machines, motors, transformers, lamps, conductors, armatures, etc., find a large sale. In response to this demand, workshops and factories have been established which produce more particularly the accessory supplies and conductors. There are but two factories in Russia which produce electric machines and lamps, and in consequence most of these are imported. Germany and Switzerland furnish the largest number; next comes England, and then follow the United States, France and Belgium. Statistics on the subject are not obtainable at the present time. It is possible, however, to estimate approximately the situation of certain branches of electrotechnical industry in Russia, and this estimate is undoubtedly below the actual condition.

ELECTRIC LIGHTS.

A few years only have passed since such cities as St. Petersburg and Moscow began to have their streets lighted by electricity. At present there are more than fifty towns which employ the electric light, and many other places are erecting the necessary apparatus. The rapidity with which the use of electricity has spread at St. Petersburg will serve as an example of the popularity of this manner of lighting. The first central station was installed in the city in 1881. The power of that station was about 250 kilowatts. Until 1885 there were only a few stations opened, and the power increased very slowly. After that year the power of the stations and their number grew rapidly, and in 1898 there were 169 stations, having together 29,000 kilowatts of power. In 1898 and 1899 three additional central stations were constructed in St. Petersburg, and at the present time the power of all the central stations taken together (exclusive of the private stations) reached 15,000 kilowatts. Work near completion will raise the power at these stations to 30,000 kilowatts. The number of private stations is about 300, and these have a total power of more than 39,000 kilowatts. St. Petersburg is lighted by means of arc lamps on the principal streets and by incandescent lamps on ways of less importance. In addition to the arc lamps on the streets there are about 300 lamps fed from private stations. Electromotors, having a power of about 4,500 kilowatts, have been constructed. In many of the private stations accumulator batteries have been put up, and their capacity exceeds 50,000 ampere-hours. The number of dynamo machines erected at these stations is over 500. As a rule, the current is continuous. Steam motors are principally employed, but gas motors and petroleum motors are also in use.

All of the large stations work with alternating currents, and one of them uses the triphase current. The greater part of the network is underground, and consists of armored cables. Air conductors are not in use, except at a few stations. The aggregate length of the network is over 6,225 miles. The tension of the current of this network is from 2,000 to 3,000 volts.

In Moscow and in other towns, both large and small (particularly those situated in the industrial region), the use of electricity has made no less rapid progress than in St. Petersburg. In the beginning the stations constructed were almost all for the continuous current, but in the later ones the preference was for the monophase and triphase alternating current. The network is sometimes underground and sometimes overhead.

ELECTRIC TRACTION.

Electricity is also coming largely into use for tramways. The first electric tramway built in Russia was the one at Kief, which dates from 1893. In 1898 forty-five cities had constructed such lines, their length exceeded 312 miles, and nearly 10,000 kilowatts were in use for the motors. The number of motor cars was about 300, and there were many cars without motors. Most of the tramways are worked by a continuous current. The total length of wire for the electric tramways in St. Petersburg is estimated at 1,875 miles. Air conductors and underground conductors will be used, and on the principal streets accumulator traction. Nearly 400 motor cars will be in use, and 300 without motors. Other cities also contemplate the employment of electricity on a large scale, and plans are under consideration for its use on the great railroads of Russia. These projects include the construction of an electric railroad to connect neighboring towns on the western frontier of Russia, and the establishment of a road to cross the Caucasus Mountains, between the towns of Suhkum and one of the stations of the Vladikavkas Railway. For this latter road it is proposed to utilize the hydraulic force of the mountain streams. Electric traction is already in use on the railroads, serving large factories, in the mining industry, and in other enterprises.

The use of electricity for the distribution of motive power is spreading, and today all of the machine works of Russia have adopted this method. Enormous central stations have been erected at places where such factories exist; for instance, at the Kolomna machine shops, at the works of the Sormovo Association, at the Putilov works, and many others. All of the larger elevators on the Vladikavkas Railway and on the Moscow-Kazan Railway are supplied with electric motors. Up to the present, electricity has scarcely been used at all for the transmission of energy for great distances. Projects, however, are under way to utilize the waterfalls of Marva and Imatra. The Russian Government has granted a concession to a company to supply power to St. Petersburg from the Volhov rapids. The estimated cost of the enterprise is about $14,000,000. It is said that the power to be transmitted will equal 150,000 kilowatts, and the maximum transmission distance is 188 miles. The company has undertaken to provide the pub-

lic lighting of St. Petersburg gratuitously, and hopes to furnish current to individuals at about half the price hitherto charged in similar enterprises. The engineer of the scheme is a Russian named M. Dobrotvorsky. It is also intended to use the colossal force of the Dnieper cataracts for the transmission of energy.

ELECTROCHEMICAL INDUSTRY.

The progress of the electrochemical industry and of electrometallurgy is interwoven with the utilization of hydraulic force as motive power. For instance, there are even now several establishments which obtain copper and refine metal by the electrolytic process. Such establishments exist in the Urals and the Caucasus, and have an output that is important. Thus, the works of Siemens Bros. at Kedabeg, in the Caucasus, annually produce some 500 tons of copper. Many less important works in St. Petersburg, Moscow, Nizhni Novgorod, etc., utilize steam power for the refining of copper and impure copper waste by the electrolytic process. Some of these works obtain as by-products of the electrolytic process other metals, such as lead, antimony, etc. There are as yet very few special electrochemical works in Russia; one factory near the Imatra rapids produces carbide of calcium, and other works for a similar purpose also exist. A large electrochemical factory has been erected in the government of Kharkof, for the production of caustic soda. Electric soldering is in use in metallurgical and mechanical works, and also in the railroad shops; this is accomplished with the aid of the Voltaic arc, a Russian invention. It is said to be superior to the ordinary welding by fire, and is in use in seventy important machine works in western Europe.

ELECTRIC APPLIANCES AND MACHINES.

It will be seen that the application of electricity has progressed in Russia, and that electrotechnical appliances will have a great future in this country. Russian factories can not supply the demand, and the deficiency is made up by foreign firms which have their representatives here. It is true that Russian manufacturers produce many cables and insulated conductors. At St. Petersburg and Moscow there are a number of factories in this line, and their output compares favorably with the foreign articles. The most important of these establishments is the Siemens and the Riben, both of which produce cables of the most complicated character. Nevertheless, cables in large quantities are imported from abroad, the home manufacturers not being able to supply the market. Accumulators are also manufactured in various towns in Russia. There are a number of establishments in St. Petersburg which produce accumulators of original design or after the best known foreign models, such as the Julien, the Tudor and others, and the importation is small. Such appliances as circuit-breakers, commutators, rheostats and carriages, as well as armatures for lamps, are also manufactured in Russia, but not nearly enough to supply the demand. Measuring and counting instruments are scarcely manufactured at all in this country, although the demand for them is enormous, especially of late, since central stations have been constructed in a number of towns. These instruments are imported from France and Germany. The manufacture of porcelain insulators and of porcelain appurtenances in general is so largely developed in Russia as to completely satisfy the home demand, and no insulators are imported. Incandescent lamps are not manufactured in Russia at present; an establishment formerly existed for the manufacture of these lamps, but foreign competition was so strong that the attempt was abandoned. The lamps are at present imported from Germany, France, England, Austria and Sweden. Arc lamps are produced in this country, but only in limited quantities, and the greater number of those used are imported from Germany. Carbons for the arc lamps are also manufactured in Russia, though most of them come from abroad.

As regards electric machines, such as dynamos, motors and transformers, they are manufactured by only one firm—Siemens & Halske, at St. Petersburg. This house makes annually dynamo machines and motors of which the aggregate strength is about 6,000 kilowatts. It is also the only firm in Russia which produces appliances required in electric traction.

One branch of the electrotechnical industry is fully supplied by the home manufacturers, and that is the signaling and telegraphic apparatus in use on the railways, to indicate whether the road is open or closed. As regards telegraphic appliances proper, some are manufactured in Russia and some come from abroad, chiefly from Sweden and Germany.

HOW TO EXTEND UNITED STATES TRADE.

It will thus be seen that the demand for electrotechnical apparatus and machines in Russia is relatively but little satisfied by the home manufacturers, and the progress in the application of electricity for transportation, manufacturing and domestic economy will undoubtedly enormously increase the market for foreign appliances. American manufacturers should have their share of this trade, and there is but one way to secure it—that is, to establish branch houses in this country and place the same in the hands of competent men. The Germans hold the field in supplying this country with electric appliances, because they are ever present and always patient; they study their customers, ascertain their financial condition, give long credit with reasonable interest, and employ men who are either German-speaking Russians or Germans born in Russia, who, of course, speak both Russian and German.

It will require more than a casual visit to Russia on the part of our business men if we are to win our proper share of the future business to be done in electrical appliances. It is not too much to say that in no other branch of trade is there likely to be such material progress in Russia.

THOS. E. HEENAN,
Odessa, Russia, July 12. Consul.

The Pennsylvania Street Railway Association.

Much interest is being manifested in the next annual meeting of the Pennsylvania Street Railway Association, which will be held at York, Pa., on September 10 next. The programme will be an interesting one, and will contain several features which will make it of value to those who are fortunate enough to be present.

The officers of the association are: John A. Rigg, president; John Ruth, secretary; W. H. Lanius, treasurer. The executive committee is composed of the following members: William B. Given, B. F. Meyers, John Ruth, W. H. Lanius and John A. Rigg, with headquarters at Lebanon, Pa.

A Simple Telephone Receiver for Wireless Telegraphy.

Mr. L. Bleeckrode, while engaged in testing an installation for wireless telegraphy between The Hague, Holland, and a government lightship lying at a distance of sixteen kilometres from shore, devised a simple apparatus which yields excellent results. Two parallel pieces of carbon, like those used in an ordinary arc lamp, having a length of five centimetres, were placed on a square piece of wood, and a couple of dry elements and an Ader telephone placed in circuit. The circuit was completed by placing three or four ordinary sewing needles loosely in transverse directions on the carbon rods. The antenna of the signal mast is joined to one carbon, and the other is connected to the earth conductor. The letters of the Morse alphabet were very distinctly heard as shorter and longer taps in the telephone, and at the given distance telegrams were easily read by sound by a trained operator, and more quickly than they could be delivered by the usual coherer arrangement combined with the Morse writer.

THE CONSTRUCTION OF TELEPHONE EXCHANGES—XXXVIII.

BY A. E. DOBBS.

In Fig. 158 was shown an outline diagram of a portable test set, and Fig. 159 shows the connections to the various studs as they are made in the box of one manufacturer. The coil connections are not shown, as they are understood to be connected from one plug to the other, and that putting a plug in a hole short-

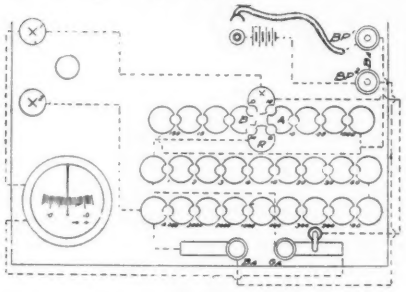


FIG. 159.—SHOWING CONNECTION TO STUDS.

circuits the coil. (See Fig. 160.) We find in the centre of the top row of studs four studs set diagonally, which constitute the commutator or circuit changing switch already shown in detail in Fig. 158, connecting X and R to the ratio arms A and B.

At the upper right-hand corner are two posts, BP^1 and BP^2, which connect with the battery of five or six cells that usually accompanies a set of this kind, connections being made to the battery in the above case by means of one—sometimes two—flexible cord. Should an outside battery be found desirable, as in the measurement of high resistances, where a battery of from 50 to 100 volts is often used, the flexible cord can be disconnected from the box battery and the outside battery connected to the binding to the cord posts instead.

At the upper left-hand corner are two posts marked X^1 X^2, to which the unknown resistance is connected (in some sets these posts are marked C and D), while in the lower left-hand corner is the galvanometer, which is cut into circuit by means of the strap keys BA (battery) and GA (galvanometer). The B ratio arm has three coils of 1, 10 and 100 ohms, while the A arm has coils of 10, 100 and 1,000 ohms resistance, thus giving a possible range, by unplugging the 1-ohm coil in B and the 1,000-ohm coil in A, 1,000 times that of the rheostat, which in the present case would be $11,110 \times 1,000 = 11,110,000$ ohms. It is, of course, theoretically possible to go even higher than this by leaving out all the plugs in the A arm and plugging all but the 1-ohm coil in the B arm, thereby obtaining a ratio of 1,110 to 1, or a total reading of 12,332,100 ohms, but this is not a practical scheme by the ordinary bridge method, because as the reading goes beyond 500,000 ohms the accuracy falls off quite rapidly.

In the second and third rows of studs we have the rheostat coils.

Beginning with the second row we have coils marked 1, 2, 3 and 4—the units—which combined make 10 ohms, or any unit number less than 10. In the second half of this row we have the tens, composed of 10, 20, 30 and 40 ohms, which combined make 100 or any combination between 10 and 100, and in combination with the units giving any reading between 1 and 100 ohms on even bridge. In the same way the hundreds are formed in the third row up to 1,000 and the thousands up to 10,000.

There are two methods of connecting up the studs of a plug bridge, one being the straight or series plug plan shown in Fig. 160, which shows the resistance coils in series between the studs from one end of the row to the other, the coils of which

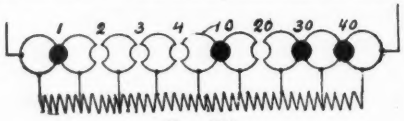


FIG. 160.

are cut in by leaving out plugs and short-circuited by putting them in, the reading in that particular figure being $20 + 4 + 3 + 2 = 29$ ohms. This form requires as many plugs as there are coils, but at the same time reduces the number of coils to the lowest possible limit. The objection to this form is the large number of plugs required, which are liable to get dirty or lost, each one of which introduces a possible error factor, the resistance of each plug probably averaging 0.1 of an ohm.

The "decade" plan of bridge shown in Figs. 161 and 162 is still quite a popular form with some wire chiefs on account of its simplicity.

Instead of each stud being connected in series the resistance is cut in by placing a plug between the stud and a bus-bar, one plug only being necessary for each row of studs. As shown in Fig. 161, the A and B arms are next to the galvanometer. The rheostat consists of four rows of studs and bars of test coils, each named respectively units, tens, hundreds and thousands, up to a final reading of 10,000, or a total of 11,111 ohms. On the right is a row of six cells of battery, the studs of which are made to fit a plug on the ends of the flexible cords shown, so that one cell, or the entire six, can be connected as desired. The binding-posts to which the cords are connected can also be connected to an outside battery. There is no commutator to reverse the ratio arms, that being accomplished by changing the ratio values of the plugs.

While on this subject of contacts it might be well to mention the fact that some manufacturers have recently brought out a circular sliding or step switch rheostat — Fig. 163 — which is much better than the plug form, as plugs wear to a poor fit in course of time and break, or frequently get lost, as said before. This switch, as in the decade form, can not make more than six contacts, another advantage in eliminating errors. The principal reason why the circular switch contact has not been used heretofore — though the British Post Office has had it for years—has been the uncertainty of the rubbing contact on a flat surface, which, however, has been overcome in the present instance by a contact arm made of several sheets or leaves, bent over so that the ends, instead of a flat surface, rest on the stud.

Each leaf having a separate bearing of its own, and the rubbing contact being self-cleaning, there is no reason why this form should not be even better than the best plug contact, let alone the average run of them when made with dirty plugs.

The A and B arms are also circular switch contacts. There is no reversing plugs as in Figs. 158 and 159, so that

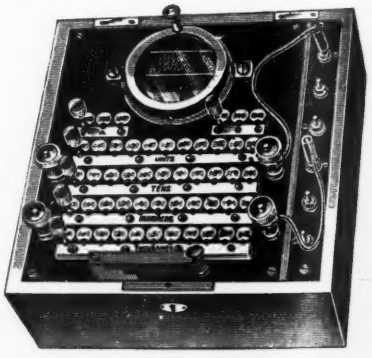


FIG. 161.—SIMPLE FORM OF BRIDGE.

we get a multiplying or dividing factor by changing the relative ratios of the arms, which requires some explanation. In the ratio arms shown in Fig. 159 the A coils are marked 10, 100 or 1,000, and the B arm, 1, 10 or 100. In order to simplify matters we will call the A arm the high ratio or long arm, and B the low ratio or short arm. The object in making the arms in this manner was to make the reading as nearly automatic as possible to the inexperienced user, or, perhaps, to ensure greater accuracy, as it is easier to secure accuracy in a low

resistance coil than in one of high resistance. Then there is a slight economy in the matter of winding, as there is saved one 1,000 and two 10,000-ohm coils.

With a commutator or ratio reversing plug switch, as shown in Fig. 159, A to R and B to X gives a dividing ratio in the rheostat—that is, the reading is divided by the ratio between the arms. Supposing that A is higher than B, as it should be, table I gives the best bridge values for ordinary use.

TABLE I.

Plugs, A to R; B to X.

Unknown Resistance.	Resistance Unplugged. A.	B.	
Below 10 ohms.	1	1,000	Divide by 1,000
10 ohms to 100 ohms.	10	1,000	" 100
100 " 500 "	10	100	" 10
500 " 5,000 "	100	100	Even
Now reverse the plugs placing A to X and B to R.			
5,000 to 50,000 ohms	100	1,000	Multiply by 10
50,000 " 500,000 "	10	1,000	" 100
500,000 " 11,000,000 "	1	1,000	" 1,000

Another manufacturer sets his reversing plug in a slightly different manner,

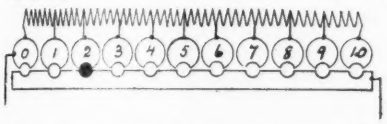


Fig. 162.—Showing Connection between Stud and Bus-Bar.

gives the ratio arms the values of B = 10, 100, 1,000 and A = 1, 10, 100, just the reverse of that given in the previous example—and also gives the following table as the best reading values for his instrument:

TABLE II.

A to X; B to R.

Unknown Values.	A.	B.	
Less than 20 ohms.	1	1,000	Divide by 1,000
20 to 200 "	10	1,000	" 100
200 " 2,000 "	100	1,000	" 10
2,000 " 20,000 "	100	100	Even rheostat
Reverse plugs A to R; B to X.			
20,000 to 200,000 ohms.	100	1,000	Multiply by 10
200,000 " 2,000,000 "	10	1,000	" 100
2,000,000 " 21,000,000 "	1	1,000	" 1,000

This difference in commutator plugs and ratio arms is very confusing to the beginner, and sometimes makes even experienced electricians look twice to see just where they are. The practical man, however, would lay a nail or other piece of metal across the X-terminals, set the ratio arms at 1,000 to 1, and adjust the rheostat arm till a reading was obtained. If that should be found impossible he would reverse his plugs and manipulate the rheostat till a balance was reached. Knowing that the resistance of the contacts and piece of metal must be less than 1 ohm, he would then know that the position of his plugs indicated a division of the rheostat reading by 1,000, and that an opposite connection would indicate multiplication of the rheostat reading.

In the tables given above, the usual bridge formula $X = R\frac{A}{B}$ or $\frac{B}{A}$ $R = X$ is all right, but as in the two examples shown, they are worked in opposite directions, we are as much at a loss as ever to know which formula is right unless we have the manufacturer's sketch, or make some such a test as already referred to.

When, however, we have a permanent connection to one side, as in Fig. 164, where A is permanently connected to X and B to R, then our ratio formula of $\frac{A}{B}R=X$ remains constant, no matter what the ratio arms might be, a condition we have in Figs. 161 and 163, where, if the A arm is lower than the B arm, division of the rheostat arm takes place, as, if we have A = 10, B = 10,000 and R = 12, then we should have 10 ÷ 10,000 × 12 = 0.012 of an ohm as the value of X. On the other hand should A = 1,000, B = 10 and R = 1,876 we should have 1,000 ÷ 10 × 1,876 = 187,600 ohms.

The readings given in table III indicate the best values for the bridge where accurate readings are desired.

As the bridge arm contains 11,110 ohms, many young fellows, where great accuracy is not required, simply balance the bridge by making both ratio arms alike, as when both are set to 10, 100, 1,000 or even 10,000, but this does not give such an accurate reading, nor is it so quickly found, and it sometimes happens that shop hands will wind a coil for 250 ohms and not get much closer to it than 10 ohms either way; whereas, with the ratio arm set at 0.1 of the rheostat they could not get more than one ohm out of the way, as the rheostat arm would step in tenths, and the galvanometer not come to rest till nearly right.

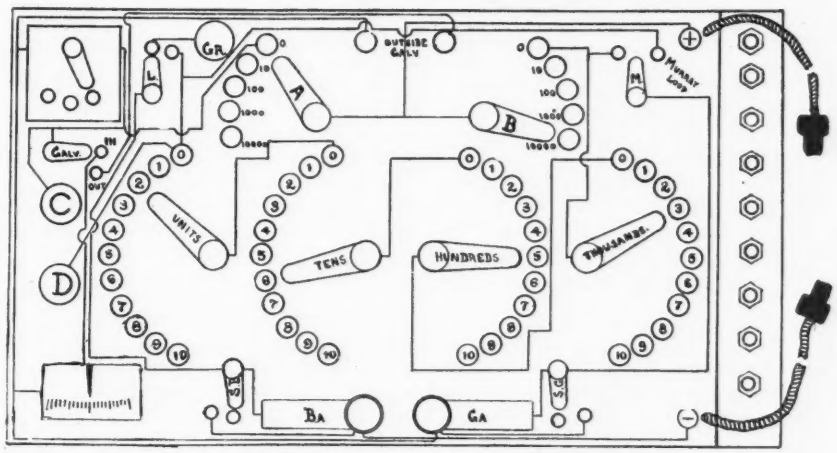


Fig. 163.—Showing Circular Sliding or Step Switch Rheostat.

While discussing the bridge shown in Fig. 163 we will notice and describe its design in a general way.

The rheostat is made up of four groups of coils, ten coils in each group. The resistance in each group is set by the use of phosphor-bronze springs of several leaves each, bent so as to move end on over the studs; the only coils in use are indicated by the studs the switches rest upon. The strap keys, Ba and Ga, connect to the battery and galvanometer respectively, and there is also, at the outer end of each key, a small switch which shunts the keys, if desirable, thus leaving

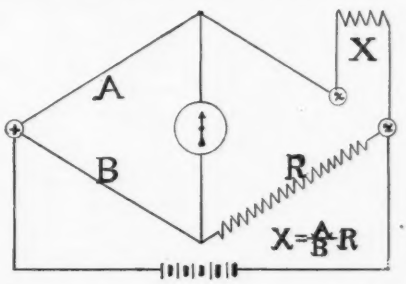


Fig. 164.—Permanent Connection to One Side.

the battery and galvanometer continuously in circuit, which is not desirable very often. At the end of the box on the right is a row of eight battery cells, any number of which can be put in use

by the flexible cords shown. The binding-posts + and —, to which each cord connects, can also be used to connect an outside battery when necessary. Sometimes, when taking direct deflection readings, as in the measurement of insulation, it is necessary to connect to a more sensitive galvanometer than the one in the box; for this purpose there are two posts, located at the middle of the upper side, marked OUTSIDE GALV., to which it can be connected by the aid of a small switch at the left marked GALV., which connects either the box or an outside instrument, as indicated by the marks "out" or "in."

At the upper left-hand corner there is also a small box, upon which is a three-contact switch. This box contains shunt coils used for the purpose of bridging the current around the galvanometer in direct readings, the proper use of which will be explained later. On the upper side there is also a post marked GR, to which a ground wire can be connected in making loop tests, as well as two switches marked L and M, which are also used in loop tests, and which will be explained in another chapter.

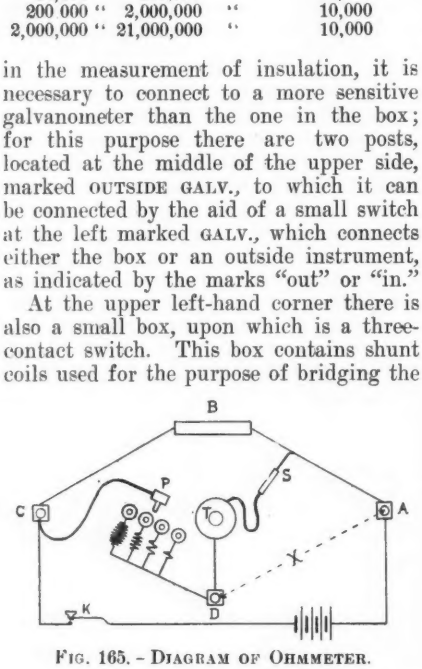


FIG. 165. - DIAGRAM OF OHMMETER.

When speaking of an outside galvanometer there is another very common instrument that is frequently used in quick testing where absolute correctness is not necessary. We refer to a common every-day telephone receiver, which can be connected to the outside galvanometer posts and the box instrument disconnected. Placing the telephone to the ear and depressing the keys lightly there will be a click in the telephone as long as there is a lack of balance, and absolute silence when a balance is obtained. Of course, the telephone will only give a single click unless the battery circuit is interrupted, as by a buzzer or pole-changer. The telephone is often more sensitive and much quicker in action than many of the portable galvanometers, and is apt to be more satisfactory in measurements of high resistance, but it is not so reliable on circuits where there is a great deal of inductive disturbance.

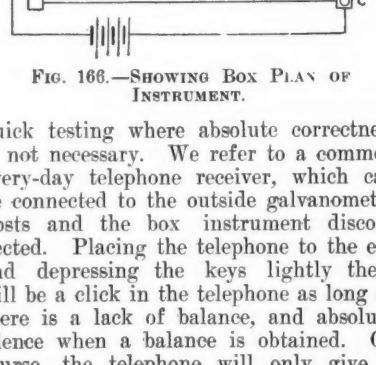


FIG. 166.—SHOWING BOX PLAN OF INSTRUMENT.

TABLE III.

	A.	B.	Ratio.
Less than 20 ohms.	10	10,000	1,000 to 1—Divide
20 to 200 "	100	10,000	100 " 1 "
200 " 2,000 "	1,000	10,000	10 " 1 "
2,000 " 20,000 "	1,000	1,000	Even bridge
20,000 " 200,000 "	10,000	1,000	10 to 1—Multiply
200 000 " 2,000,000 "	10,000	100	100 " 1 "
2,000,000 " 21,000,000 "	10,000	10	1,000 " 1 "

This brings us to another instrument lately put upon the market, known as the "Ohmmeter," which is a combination of telephone and slide wire bridge. The slide wire bridge is not new, it being a straight piece of high resistance wire, which is marked off in steps along the wire.

Fig. 165 shows a diagram of an ohmmeter, which resembles the bridge plans already given, but with different connections to the battery and unknown resistance.

By comparing Fig. 165 with Fig. 164, we find that the connections are, as if X, the unknown resistance, should take the place of R, R takes the place of B and acts as a ratio arm, A the position of X, and B the place of A.

A and B are the variable arms from which the resistance is read, although A + B are constant to each other and never changed. A and B are simply two straight pieces of wire connected into one of very high resistance and an infinite number of steps, as the pointer or stylus, S, can touch any part of it. The telephone receiver, T, indicates when a balance has been obtained, and the figures, placed on a scale alongside the wire, the resistance in ohms A switch K, a small button placed on the receiver closes the battery circuit. Should it be desired, a reflecting galvanometer can be connected in place of the receiver, where very great sensitiveness is required.

The rheostat resistances, reading from left to right, are respectively 1,000, 100, 10 and 1 ratios. In order to simplify the readings these, the ratio studs, are marked brown, blue, red and black, and letters of these colors placed beside the scale indicate the correct readings of the stylus, S, which must correspond with the stud color.

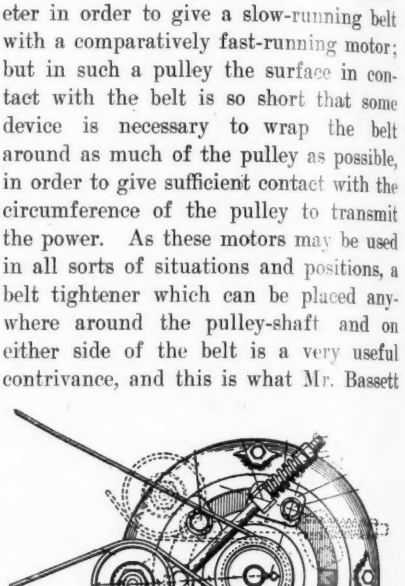
Fig. 166 shows the box plan of the instrument, the receiver being connected by four cords; one, a loop in the battery circuit to the push-button K, and the other the regular receiver winding connecting with the pointer S.

The unknown resistance is connected to the posts A, D.

Should it be desirable to test with an alternating or interrupted current, the battery and interrupter are connected to the primary circuit by an induction coil, and the secondary of the coil connected to the binding-posts, A, C, the same as the battery now is.

Electrical Patents

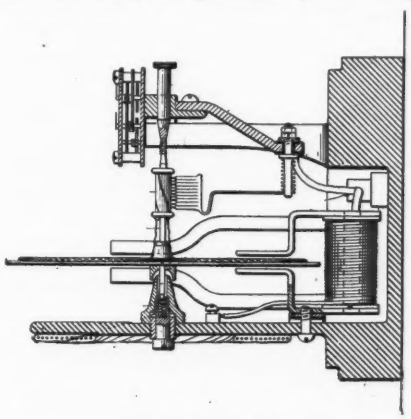
The General Electric Company has obtained control of a patent on a belt tightener invented by Mr. Norman C. Bassett, of Boston, Mass. In small electric motors designed to be belted directly to slow-running machines—such as printing-presses, typesetting machines, machine tools and the like—it is desirable to use a driving-pulley of very small diameter in order to give a slow-running belt with a comparatively fast-running motor; but in such a pulley the surface in contact with the belt is so short that some device is necessary to wrap the belt around as much of the pulley as possible, in order to give sufficient contact with the circumference of the pulley to transmit the power. As these motors may be used in all sorts of situations and positions, a belt tightener which can be placed anywhere around the pulley-shaft and on either side of the belt is a very useful contrivance, and this is what Mr. Bassett has devised. He employs a support which is adjustable concentrically with the motor-shaft, and upon the support is journaled an idler-pulley adapted to engage the belt. Another support is also journaled concentrically with the driving-shaft, being likewise adjustable, and an arm connects the two supports, being pivoted to one and having a slidable engagement with the other. A coiled spring surrounds the arm and tends to pull the idler against the belt, thus keeping the latter tight. In one form of the invention the motor-casing has an annular undercut groove concentric with the driving-shaft of the motor. In this groove is slidably mounted a curved plate, to which the idler is journaled. The plate can be held against movement by clamping bolts. Another plate is also slidably mounted in the groove, and can also be fastened against movement, this plate carrying an



A NEW BELT TIGHTENER.

eye. The arm is pivoted to the idler-plate and passes through the eye, its projecting ends having a coiled spring bearing against the eye, and thus urging the idler into engagement with the belt. In another form the plate is swiveled upon the shaft, a link being pivoted to the plate and carrying the idler. In this instance the spring-pressed arm is fastened to the free end of the link, and is secured in an eye suitably attached to the frame.

Professor Elihu Thomson has devised further improvements in electric meters, and has disposed of the patent obtained thereon to the General Electric Company. The object of this invention is to simplify and cheapen the construction and render the operation of the meter uniform over all ranges of load. It is especially applicable to meters operating under direct current. He describes his invention as follows: "In carrying out the invention I provide a register driven by a meter-motor at a speed varying with the load on the consumer's circuit, in which the meter is installed in a manner usual with electric meters, and in order to simplify the construction I employ a motor comprising an armature or torque-producing element, formed of a plurality of flat or 'pancake' coils, moving in a magnetic field of constant strength. The field may be excited in any desired manner, but I prefer, for the sake of cheapness and convenience, to employ one or more permanent magnets, between the poles of which the pancake coils are mounted for rotation. As many such coils as desired may be employed and symmetrically disposed about the axis of rotation and supported in a common plane, to which the load current of the consumer's translating devices is led through a suitable commutator. For cheapness of construction I prefer to employ a commutator formed of three segments and a corresponding number or multiple thereof of armature coils. The small number of segments also permits the commutator to be made of small diameter, thus rendering brush-friction low. A type of commutator suitable for my purposes is that employed in the well-known Thomson-Houston three-coil dynamo for arc lighting. In shunt to the armature is a resistance of such value as to take the maximum portion of the current flowing through the meter. With an organization of the kind just outlined the effect of the friction of the moving parts is such that it is impossible to so adjust the meter that it will register the energy consumed with substantial accuracy, both at low and at high loads. If the meter is so adjusted that its registration is accurate at the normal load for which the meter is constructed, there will be a considerable inaccuracy in the registration at very low loads, due to the fact that the friction of the moving parts, which is substantially constant at all speeds, becomes a greater proportional part of the load as the load on the meter decreases. The load due to the friction of the moving parts is, however, small in comparison with the load on the meter when a full-load current is flowing in its actuating windings. It is therefore possible to materially increase the accuracy of registration at low loads without decreasing by so great an amount the accuracy at full load by so adjusting the meter that its registration will be correct at some point intermediate between zero and full load, the particular point being



A New Electric Meter.

determined in accordance with the range of load to which the meter is likely to be subjected. The meter, when thus adjusted, will, of course, register too low at low loads and too high at full loads, but its accuracy will on the whole have been substantially increased. It is not, however, possible by such an adjustment to make the registration accurate at all loads up to the full-load limit for which the meter has been designed. I have found that it is possible to so modify the organization above specified that the registration of the meter may be made substantially accurate both at light loads and up to the maximum load for which the meter is designed, and it is one of the features of my present invention to provide such a meter with a corrective which will obviate the inaccuracies above referred to, and will render the registration of the meter truly proportionate to the load on the circuit. In carrying out this feature of my invention I employ a retarding-magnet system, comprising, in addition to the damper which slows down the speed of the meter-motor at all times, an auxiliary damper, consisting of an electromagnet carrying a current varying with the load in the consumer circuit, and provided with an iron core so proportioned that its magnetization will be raised to or near the point of saturation as the meter-load approaches a maximum. The magnetization of this auxiliary damper is, of course, nil at zero load, but as the load comes on its damping tendency rapidly increases until when the load approaches a certain value, where the core of the electromagnet approaches saturation, the curve representing the retardation due to the auxiliary damper becomes flattened, and the effect of the said damper thereafter is substantially the same as that of a permanent magnet. With such a construction I so adjust the meter that it registers with substantial accuracy at full load, when the core of the auxiliary damper is saturated. As the load falls off, that part of the retardation which is due to the auxiliary damper falls off at first slowly, and later at an increasing rate as the magnetization falls below the bend in the 'curve of magnetization,' until finally, when the load reaches its minimum value, it becomes practically nil. By properly designing the electromagnet constituting the auxiliary damper its effect may be made to exactly compensate for the frictional resistance of the moving parts of the meter, so that the curve of registration will be substantially a straight line up to the maximum load for which the meter is designed, it being understood that beyond this load the curve of registration is likely to fall off somewhat, probably by reason of the disproportionate counterbalancing effect of the counter-electromotive force generated in the meter armature at such loads. For convenience of construction I prefer to embody the damping disc, commonly employed in meters side by side with the armature coils, permitting them to rotate in the same magnetic field. However, such is not an absolutely essential arrangement of the parts, and is adopted simply for compactness and convenience. So, also, the compensating device might be located in relation to another part of the rotating structure, but for the same reasons is preferably placed in cooperation with the combined armature and damping disc."

Consul Frank D. Hill, of Amsterdam, under date of July 24, 1902, writes that it would be advisable for exporters of iron, steel, coal, and electrical supplies to send catalogues to that consulate, as he intends to devote a room exclusively to circulars of American firms, folders of American railways, steamship lines, cable companies, etc.

Reviews of Current Engineering and Scientific Literature.

Giving Concisely the Substance of Important Papers in the Scientific, Electrical and Engineering Press of the World.

Electrically Driven Centrifugal Pumps in the Horcajo Mines, Spain.

In this letter, Mr. P. H. Ziegler, engineer, gives some figures as to the performance of the centrifugal pumps in the Horcajo Mines. A description of this installation was given in these columns a short time ago. The pumping plant consists of a series of induction motors, coupled directly to centrifugal pumps placed at different levels in the shaft, and pumping in series. The figures given show the practical and economical performance of the centrifugal pumps. Making allowances for stoppages, the average deliveries per minute have varied from 3.75 cubic metres in 1900 to 3.97 cubic metres in 1902. Some trouble was caused by the caving-in of quartz-bearing clay, which rendered the water very muddy. The pumps, however, worked perfectly in spite of this during the whole period the muddy water had to be dealt with, this lasting six weeks. Stoppages have been few and are decreasing. For the six months of this year, the pumps have been running continuously, except for nine hours and ten minutes, nearly ninety-eight per cent of the time. The cause of stoppage is almost always to clean the wire cage of the suction pipe at the bottom of the shaft. Experiments show that the maximum efficiency of the pumps and motors was 75.94 per cent, 3.8 cubic metres of water being delivered per minute. With this performance, the efficiency at the switchboard was 68.29 per cent.—*Engineering* (London), August 8.

The Electrical Industry and Technical Education.

This paper by Mr. Rankin Kennedy is a contradiction of the rather general belief that technical education in England is very imperfect. He claims that there are many well-trained, capable engineers who are at present either unemployed or working for very small compensation. The trouble with the British industries has been caused by the manufacturers themselves, as they have not recognized the value of technically trained men and but in few cases are willing to spend the money necessary to obtain their services. In answer to the London County Council, he says that there are plenty of funds and schools, although the general arrangements for classes do not give the best practical results, nor is the teaching suitable preparation for a scientific industry; there is no lack of trained men, since foreigners can secure them by paying for them; that the lack of advanced institutions for the above work is not a serious matter, as the men at present in demand are not those who have been through training of this kind. The present difficulties have been brought about by the tendency of manufacturers to build up a business to a certain extent, making progress for a few years, and then resting content at that level. England at present has everything necessary to successful scientific industry. The only thing needed is a realization of the causes of the present stagnation and a persistent effort to advance.—*Electrical Review* (London), August 8.

Effect of X-Rays on Very Small Electric Sparks.

In this note, Mr. M. R. Blondlot describes an interesting phenomenon which he noticed while working with a sparking coil in the neighborhood of an X-ray tube. This effect is different from that discovered by Mr. Swyngedauw in 1896, namely, that X-rays increase the sparking distance of a coil for a given potential. The apparatus used in this experiment consisted of an induction coil connected to two copper bars, each about fifteen centimetres long, with points filed smooth and arranged so that the gap between them could be varied. Beside this, and parallel to it, was placed a Crookes tube operated by an induction coil. At each discharge of the tube, a small spark passed between the two copper rods, which in this experiment are placed very close together. Placing a lead sheet between the tube and the spark-gap modified the character of the spark. It then assumed the aspect of a small reddish glow. By properly adjusting the distance between the sparking points, this discharge took place perfectly regular. When the sheet of lead was removed, the spark assumed its first character, being white and bright. To show that this effect was not due to induced charges on the lead plate, a plate of aluminum was substituted for this, but it was not observed to have any effect upon the character of the spark. To show that the effect was not due to static charges, the Crookes tube was connected directly to the sparking apparatus. The effect in this case was the same as before. The explanation given for this phenomenon is that the effect of the X-rays is to reduce the resistance of the air-gap, so that a greater quantity of energy passes across the gap at discharge. To observe this phenomenon, the gap must be very small, otherwise the discharge would heat the air sufficiently to reduce the resistance of the gap, and in this way mask the effect of the X-rays.—*L'Industrie Electrique* (Paris), July 25.

Steam Turbines and the Correct Type of Engine for Large Generating Stations.

In the discussion which followed the reading of the papers by Messrs. Fedden and Day on these topics, Mr. H. Kilgour said that in the steam turbine the entire absence of cylinder lubrication was important, as it permitted the use of superheated steam and the return of all water to the boilers, doing away with the need of pumpers. Mr. C. H. Wordingham thought that since the low height of the turbine permitted a reduction in the height of the engine room and hence of the building the turbine effected a considerable saving here. The saving in floor space would not be as great as had been indicated, as the same boiler equipment is required for the turbine as for the engine. Mr. S. D. de Farranti said that the turbine had been retarded by the use of unsuitable alternators in the earlier turbine sets. He did not agree in Mr. Day's statement that low-speed horizontal engines were the best for central station working, as all types were good if properly constructed and installed, and often the use of another type would greatly reduce the cost of the station. Gas engines for electrical purposes had not got out of the experimental stage, due to the difficulty of operating alternators in parallel when driven in this way, and also because of the unknown quantity as regards cost and maintenance. Mr. W. A. Chamen thought that the difficulty of building commutators for high speeds was partly responsible for the neglect of the steam turbine, and that

as regards speed the gas engine would develop along the same lines as the steam engine had done. Mr. A. B. Mountain thought that high speed was essential in all electrical work and the turbine would win the day. In round figures to reduce the consumption of steam one pound required $3,800 (£760) additional capital. Mr. J. S. Highfield thought the turbine builders should develop the inductor type of alternator as the mechanical construction of this was particularly suited for high speeds.—*Electrician* (London), August 1.

The Relative Advantages and Disadvantages of Two and Three-Wire Distribution.

Mr. John F. C. Snell in this paper advocates the two-wire system of distribution, and endeavors to show the advantages of this over the usual three-wire system. The advantages of the three-wire system as usually given are, the economy in copper, increased radius of supply and reduced percentage in variation of pressure. On the other side of the question, he gives the following disadvantages: Increased section of middle wire above that theoretically required, switchboard complications, less reliability of supply, danger of burning out consumers' lamps, electrolysis of gas and water mains, as the neutral is usually grounded, difficulty in localizing and rectifying faults. He claims that the question of economy in copper is counterbalanced by the cost of installation of the middle wire, and that the damage due to leakage is considerable, though at the present time little definite is known about this. He claims in regard to the increased area of supply that the extension involves great difficulties in securing steady pressure. Again, in short-distance systems, there is little need of a three-wire distribution. The author assumes certain conditions and goes on to show that the saving effected by the use of the three-wire system would be small in this case and counterbalanced by the troubles caused. He claims that a star-wound, three-phase generator, feeding synchronous or induction motors at substations would be just as simple as the three-wire system. When the three-wire system is used, the neutral is always grounded, and this renders the system more liable to breakdowns than a two-wire system with both conductors insulated. He believes that it will be safer to spend the additional money required for copper for the two-wire over the three-wire system to gain this reliability of service. He finally mentions a large system in London, in which the third wire is being taken out, leaving a simple two-wire system of double voltage.—*Electrical Times* (London), August 7.

Newcastle and District Electric Lighting Company's Power Stations.

This paper, by Mr. W. D. Hunter, is of particular interest at this time, as the steam turbine has been under discussion. The old station was equipped with four Parsons single-phase turbo-electric alternating generators of seventy-five kilowatts each. To this was added two 400-kilowatt continuous-current turbo-electric generators to meet the demand for electrical energy for power purposes. The works are situated on the side of a hill and had it been necessary to provide substantial engine foundations the work would have been exceedingly expensive. With the turbine, however, practically no foundations are required. There are two sets of condensers in this plant; one for surface condensation and the other for jet condensation. With these the vacuum obtained is generally within an inch of the indications of a standard barometer. It is stated that the cost of repairs and renewals for this plant during the six years it has been in operation is practically represented by the cost of inspection. The new works of this company at present being constructed are to be equipped with two units of 1,000 kilowatts capacity. These machines consist of a steam turbine directly connected to two dynamos, each 500 kilowatts, 500 volts, direct current. The automatic governor of these turbines is controlled by the voltage of the system. This is operated by means of an electric solenoid working in conjunction with a steam relay gear. The action is as follows: Should the voltage rise above the normal on change of load, the solenoid core is lowered and a small balancer piston hung at the opposite end of the lever is raised a proportionate amount. This allows the steam which keeps the regulating valve in action to escape more quickly and the valve closes a little. There is provided in addition a pulsating motion to keep all parts of the lever and valve gear in movement. The floor space occupied by each machine is 38 feet 6 inches by 6 feet, or 231 square feet. The heaviest parts of these machines do not exceed, for the cylinder bottom, five and one-quarter tons; the cylinder covers, three and one-half tons; the cylinder shaft, two and one-half tons; the armature, three tons.—*Journal British Institution of Mechanical Engineers,* July.

Penetrating Rays from Radio-Active Substances.

Mr. E. Rutherford describes in this article the results of some experiments conducted at McGill University. The permanent radio-active substances, uranium, thorium and radium, all give out two types of rays; one easily absorbed and non-deviable by a magnetic field, and the other more penetrating in character and deviated by a magnetic field. His examination of these substances by the electrical method shows that thorium and also the excited radio-activity produced by thorium and radium emit some rays as penetrating in character as those from radium. Manium, in comparison with thorium and radium, emits little if any of this radiation. These rays are extraordinarily penetrating in character and can be compared with the most penetrating rays given out by a hard X-ray tube. Since the penetrating rays present in thorium and radium and in the excited radiations due to these bodies are present in manium, it seems probable that the penetrating rays in both radium and thorium are due to the excited radio-activity produced in the mass of the compound by the emanations which are unable to escape into the air. In a search for some connection between absorption and density it was found that the quotient of absorption by density is not a constant, but the differences are no greater for the non-deviable rays than for the deviable rays of uranium. It has been shown that these penetrating rays have properties as regards absorption and ionization similar to those of rapidly moving electrons. In addition, they possess the properties of great penetrative power and non-deviation by a magnetic field, which, according to theory, belong to electrons moving with a velocity very nearly equal to that of light. It is thus possible that these rays are made up of electrons projected with a speed of about 186,000 miles per second. Elster and Geitel have recently shown that excited radio-activity can be produced from the atmosphere by exposing a negatively charged wire in the open air. Since the earth is negative with regard to the upper atmosphere, the surface of the earth itself is made radio-active as well as the whole interior surface of buildings. From the close similarity in the nature of this excited activity from the air with that from radio-active bodies it is not improbable that excited radiation from the air includes also some of the penetrating rays. In this case our bodies must be continually subject in a small degree to something like the Rœntgen-ray treatment, just now so popular in medical circles.—*Nature* (London), July 31.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

A Combination Gasoline Electric Truck for Heavy Service.

One of the most successful applications of electric power to heavy trucking has been a design which embodies the auxiliary service of a gasoline engine. The combination of a gasoline engine with a dynamo and electric storage battery has resulted in producing a driving mechanism which eliminates the objectionable features of either application as applied individually, and makes use of all the valuable features which each system naturally possesses.

The accompanying illustration shows the latest vehicle adopting this system, and is essentially a very strongly constructed truck for heavy transportation purposes. This is probably one of the largest trucks ever built which has been sold, delivered and put into daily service, the photograph being taken while the truck was making its regular trip and carrying at the time a load of very nearly nine tons. The system consists of a combined gasoline engine and dynamo, one motor for each rear drive wheel, a small storage battery and a controller. The electric circuit is so arranged that when running the vehicle under normal conditions (loaded, on the level), the current comes directly from the dynamo through the controller to the motors; but when coasting down grade, slowing up, or, in general, when less power is needed than that furnished by the engine, the current is automatically taken up by the battery, which is connected to the wiring at a point between the dynamo and controller. Again, when extra power is needed, as in ascending steep grades or starting heavy loads, the battery promptly furnishes the deficiency. This does not have to be watched by the operator, the switching-in and circuit-breaking mechanism being entirely automatic. As the output of the engine does not vary, no governor is required, and the gas and air mixtures can be set permanently for perfect combustion.

The total length of the truck illustrated is eighteen feet four and one-half inches. The width inside the stocks is five feet.

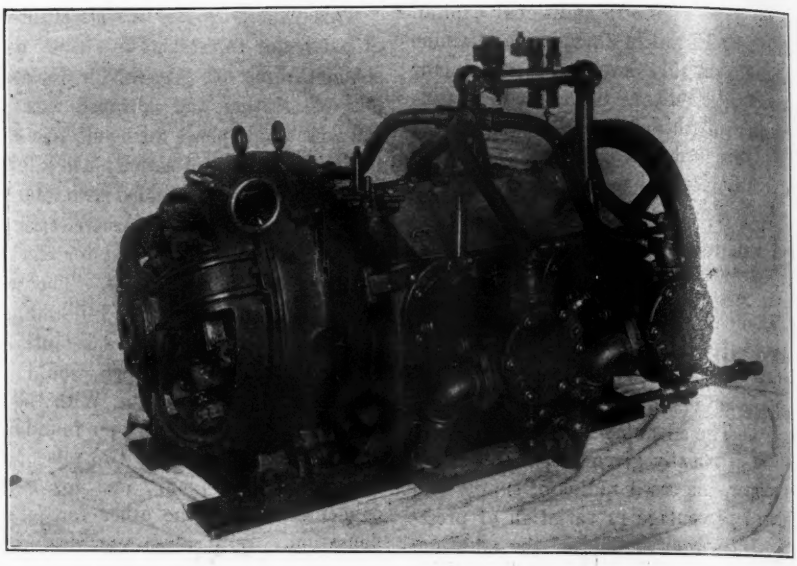


FIG. 1.—ENGINE AND DYNAMO COMPLETE.

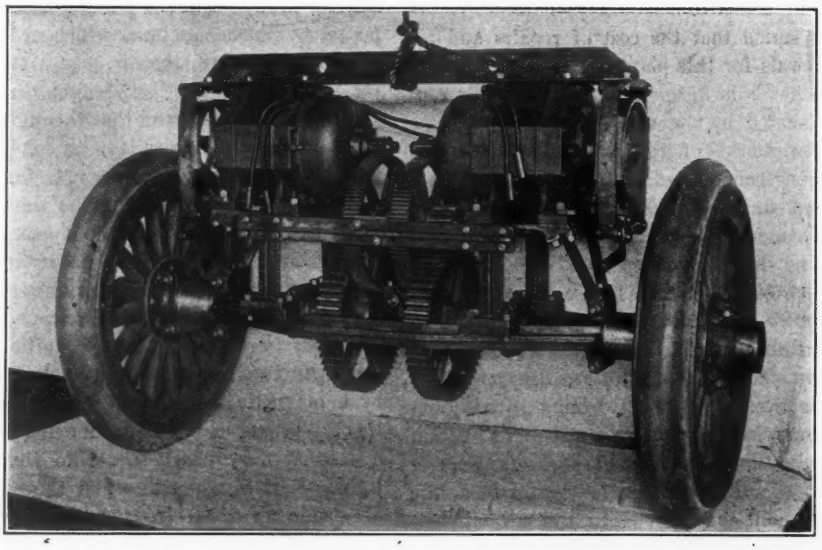


FIG. 2.—REAR AXLE AND MOTORS.

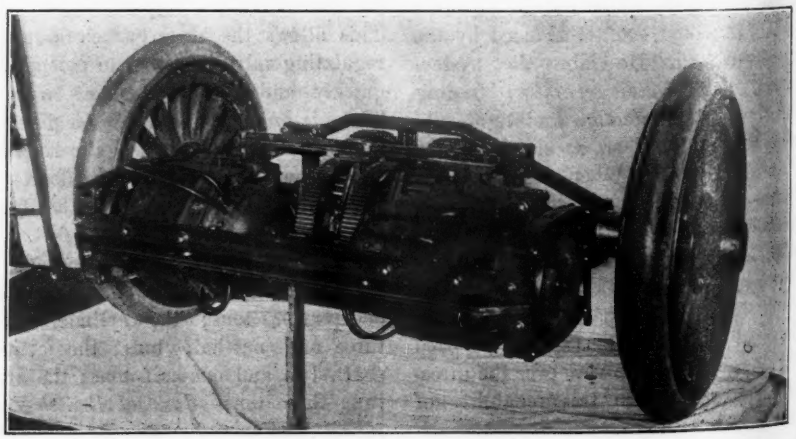


FIG. 3.—REAR AXLE AND MOTORS.

and the width over the hubs is seven feet six inches. The wheel-base is ten feet six inches long. The front wheels are thirty-six inches in diameter, and the rear wheels forty-two inches in diameter. Each wheel is equipped with seven-inch Calumet rubber tires. Both front and rear axles are thrussed. The front springs are of the platform type, the rear springs being half elliptic, with free-sliding ends. All strain due to driving is taken up by push-rods from spring saddles to the frame.

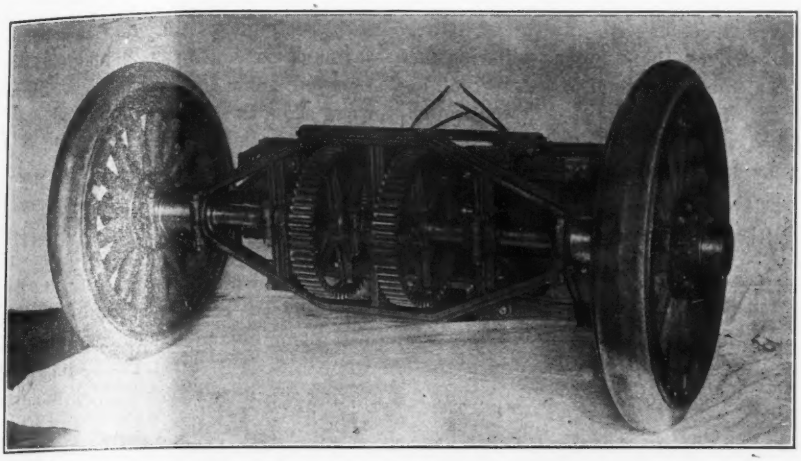


FIG. 4.—REAR AXLE AND MOTORS.

The power equipment consists of a four-cylinder (five and one-half inches by six inches) gasoline engine, coupled direct to a nine-kilowatt, 110-volt dynamo, running at approximately 550 revolutions per minute. The two motors are each of eight horse-power, capable of standing an overload of 150 per cent. The battery is composed of forty-four 136 ampere-hour cells (three-hour rate). The controller has five speeds each way, the maximum being four and one-half to five miles per hour, with full load on a level road.

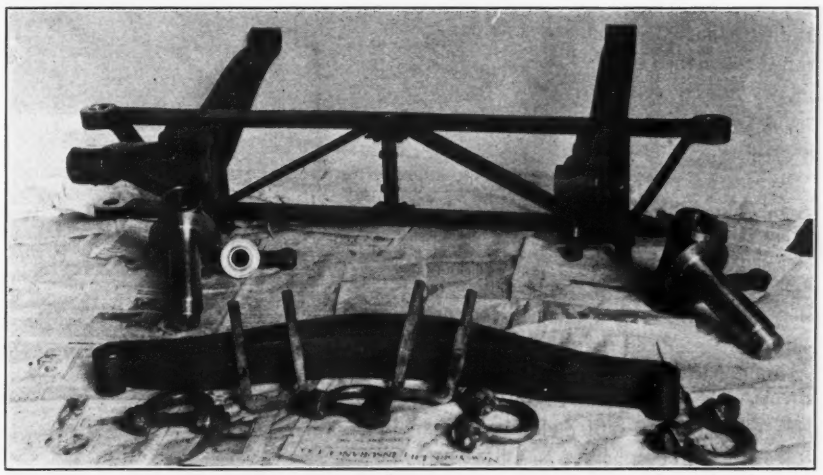


FIG. 5.—FRONT AXLE AND FITTINGS.

FIG. 6.—GASOLINE-ELECTRIC TRUCK FOR HEAVY SERVICE.

Referring to the illustrations, Fig. 1 shows the engine and dynamo complete. Figs. 2, 3 and 4 are different views of the rear axle and motors assembled as a complete driving unit, but with the gear cases removed. Fig. 5 shows the front axle, with side springs in place, but with the cross spring, steering knuckles, loops and shackles detached. Fig. 6 shows the truck complete.

While this vehicle was being tested it hauled a seven and one-half ton load over a distance of twelve miles, one-third of which was uphill, at one place the grade being about thirteen per cent. At the completion of the run the gasoline tank was filled, thereby ascertaining how much fuel was used. The manufacturer states that the cost was three-quarters of a cent per ton per mile to haul the load for twelve miles.

This equipment is manufactured by the Fischer Motor Vehicle Company, of Hoboken, N. J. Mr. S. M. Fischer, the president of the company, recently returned from London, and reports that two of the largest omnibus companies there have placed orders for buses of this type. Several other orders for heavy trucks were also secured by Mr. Fischer on his London trip. The company anticipates making such additions to the present plant that the factory space will be large enough to enable it to handle its greatly increased business.

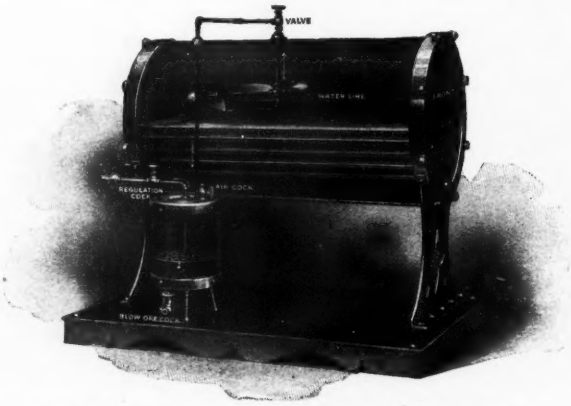
American electrical apparatus is making remarkable progress in European markets. The Société Anonyme Westinghouse has found it necessary on account of the great number of orders to make extensive additions to its plant, which has been in operation for only five years. This plant is located at Havre, France, and supplies the territory included in Holland, Belgium, Italy, Switzerland, Spain, France and their colonies and protectorates.

Mechanical Boiler Cleaners.

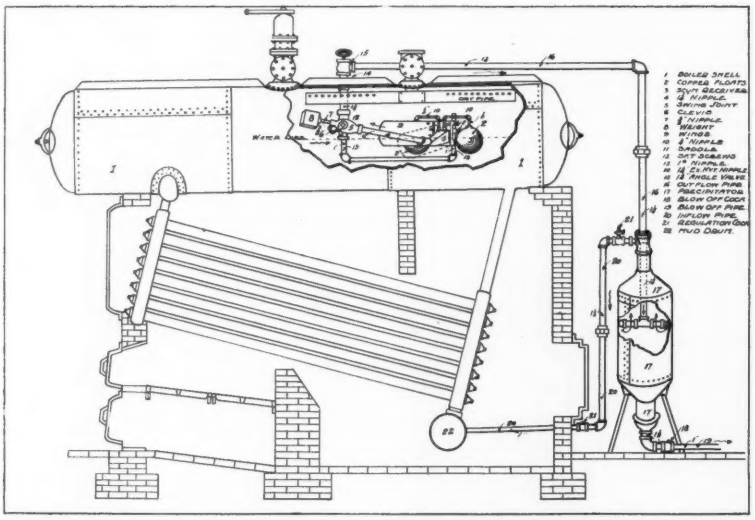
One of the inevitable conditions against which every user of steam has from time to time to contend is the formation and incrustation of scale particles on the inner surfaces of all classes of boilers. Many forms of feed-water purifiers have been devised to eliminate this tendency of water to carry sediment into the boiler, and excellent results have been achieved in this manner. The mixing of chemical elements with feed water has also been very largely tried, and great ingenuity and painstaking effort are constantly being applied to remedy this objectionable feature, which seems to be inherent with the water of every locality. There is no doubt but that the strain occasioned upon a boiler by the constant washing and cleaning, necessitated where no precautionary measures are taken, is one which greatly impairs the life and service of the boiler, to say nothing of the greatly increased consumption of fuel which becomes necessary, due to the non-conducting properties of the lining which a scale of sediment will very quickly form.

In the accompanying illustrations is shown a mechanical boiler cleaner, which the makers claim embodies many features which warrant especial consideration from all users of steam. One of the principal features of this cleaner lies in the fact that by a specially arranged method of floating the skimmer is kept constantly on the water line, regardless of the rise and fall of the water in the boiler.

The impurities in water separate under ordinary working pressures, and are held in suspension. The sediment thus formed, together with any earthy matter, is carried by the current to the surface of the water and then to the rear of the boiler. It is here arrested by the trough-shaped wings, and the sediment is taken up by the floating skimmer and discharged through the outlet pipe with centrifugal force into the precipitator. The lower temperature in the precipitator and its special construction cause the sediment to settle rapidly. It then remains in the lower compartment of the precipitator until drawn off through the blow-off pipe. The circulation is completed by the return pipe, which is connected with the boiler, and takes only clean water from the precipitator. In this manner the sediment is continuously and effectively removed from the boiler. The illustrations show this boiler cleaner adapted to two applications of boilers.



Simple Application of Mechanical Boiler Cleaner.

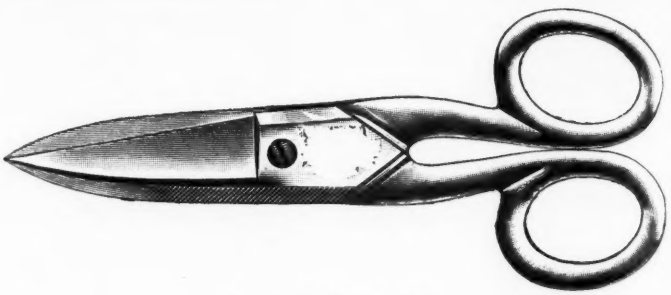


Mechanical Boiler Cleaner, Showing Detail of Assembling.

Coe, Smith & Company, 413 Western Union Building, Chicago, Ill., are the general selling agents for this boiler cleaner. This has been installed in a large number of the most important plants in the country, some of which are using from five to fifty cleaners; and these companies, it is stated, are finding a large saving in money, labor and annoyance from these installations.

Linemen's Heavy Snip.

The accompanying illustration shows a telephone or electrical snip now being manufactured by the Smith & Hemenway Company, 296 Broadway, New York city. This is made from the highest grade material and nickel-plated, and is warranted to give entire satisfaction. The snip is made very heavy and with a powerful leverage for cutting and stripping wire, and is a tool which every lineman, electrician, bell-hanger or any one who in any way strings wire will find of great service.



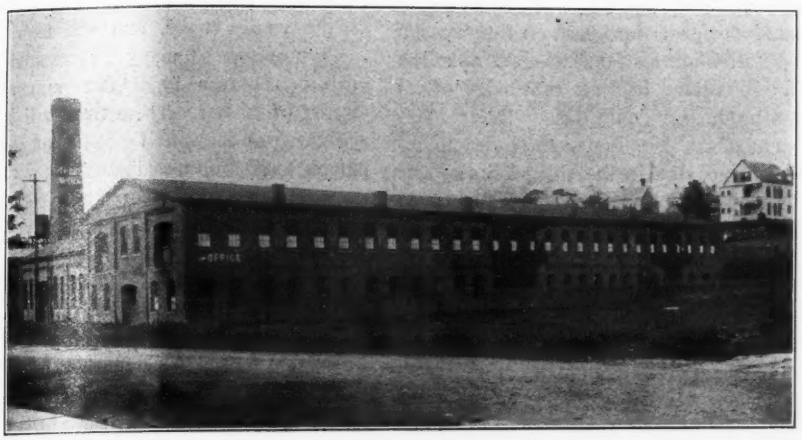
Linemen's Heavy Snip.

This summer has been a remarkable season for the elevator industry, the Otis Elevator Company reporting that within the past week it has closed contracts for no less than forty hydraulic passenger elevators to be installed in New York city in large office buildings. Last week's orders included fifty-one electric elevators for New York city alone. Several of these are of the full automatic or push-button type, where no attendant is required. It appears that with engineers and building contractors the modern Otis vertical cylinder hydraulic elevator is popular for large office buildings and hotels.

New Works for the Manufacture of Weatherproof Insulated Wire and Cables.

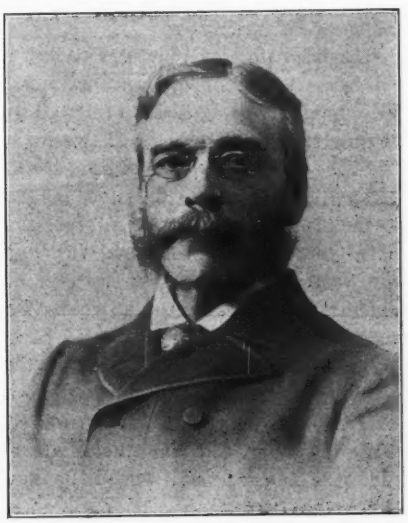
The Hungerford Electric and Manufacturing Company has established a factory at Belleville, N. J., for the manufacture of weatherproof wires and cables, using a new insulating compound which, according to recent tests made by eminent electrical experts, has shown unusually good results. This compound is claimed to be both weatherproof and impervious to the action of all acids. It does not oxidize, and for this reason its life is of long duration. In a test recently made by Dr. Louis Duncan for the Hungerford company, he reports that he reached a pressure of 8,100 volts before puncture took place, using a saturated insulation of 0.116 inch, and with the same kind of insulation, but 0.126 inch, 10,000 volts before rupture took place.

Dr. Duncan also reports that he submitted samples of this wire to a temperature of 150 degrees Fahrenheit without dripping or even displacement of the compound. The Hungerford company has a number of reports from several of our leading engineers, all of which speak highly of this new insulating compound. The company's factory is located on the Newark & Paterson branch of the Erie Railroad, opposite the Essex station. It is of unusually heavy construction, having been built by the Sisum Rope Company for the manufacture of heavy wire ropes and hawsers. It was occupied but a short time, and has now been acquired by the Hungerford company. The factory is 180 feet in depth, with a frontage of 142 feet, with walls two feet thick and two stories in height, and the roof so arranged that it can be raised at any time for the addition of a story. The company will start with the manufacture of weatherproof wire in two grades—for low and high-tension currents. It also intends to install a complete wire-drawing plant, and erect cabling machines for all sizes of cables, and, in fact, equip in a most thorough manner an up-to-date wire-drawing and insulating factory for all classes of electrical work—aerial, underground and submarine—for lighting and power, and telegraph and telephone uses.



Mill for Manufacturing Insulated Wires and Cables, Belleville, N. J.

Several subcompanies will be established for the exploitation of products which partake of a portion of the process of making this insulating compound. Plans are already under way for the establishing of a series of underground cables for telephone and telegraph work for private rental between New York and Philadelphia. This, it is expected, will be very largely used by a number of prominent financial institutions operating private lines under leases from existing telephone and telegraph companies.

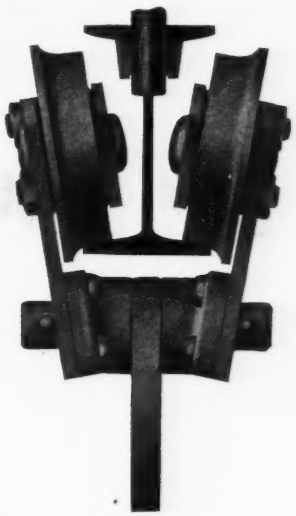


Mr. Oliver T. Hungerford.

Oliver T. Hungerford, the inventor of this compound, has spent thirteen years of constant effort in perfecting it. Besides this article Mr. Hungerford is the inventor of and designer of a wide variety of mechanical creations. The accompanying illustration shows the mill at Belleville, N. J.

Steel-Plate Trolleys.

The Brown Hoisting Machinery Company, Cleveland, Ohio, is the manufacturer of a complete line of overhead tramways and trolleys. These are built in special designs for peculiar installations, and are made from plans giving location of curves, switches, turntables, etc. Special attention is given to the capacity in pounds to be lifted, and the conditions under which the service is to be carried out. The accompanying illustration shows a steel-plate trolley of a design for special clearance dimensions. The wheels of the "Brown Hoist" trolleys are secured to steel pins revolving in adjustable bronze bearings, which give an inside as well as an outside support and materially reduce resistance to movement along the overhead beam. The trolley shown in the illustration is made for capacities ranging from one-quarter to ten tons, for I-beams ranging from four inches to twenty-four inches.



Steel-Plate Trolley.

In a gas engine, when coupled to a dynamo, the gas used to drive it for the production of electricity yields three times as much light in incandescent lamps and about eleven times as much in arc lamps as the same amount of gas would give off if burned directly at gas jets.

American Street Railway Association.

The twenty-first annual meeting of the American Street Railway Association will be held in the Light Guard Armory, Detroit, Mich., Wednesday, Thursday and Friday, October 8, 9 and 10, 1902. Papers will be presented on the following subjects: "The Registration of Transfers," by Mr. C. D. Meenely, Brooklyn Heights Railroad Company; "Benefit Associations," by Mr. Oren W. Root, Jr., Metropolitan Street Railway Company, New York; "Discipline of Employés by the Merit System," by Mr. W. A. Satterlee, Metropolitan Street Railway Company, Kansas City; "Transportation of Light Express and Parcel Delivery," by Mr. George W. Parker, Detroit United Railway Company; "Steam Turbine Engine," by Mr. E. H. Sniffen, New York; "Signals for Urban and Interurban Railways, Old Colony Street Railway Company, Boston;" "Adjustment of Damage Claims," by Mr. M. B. Starring, Chicago Street Railway Company.

All the space for exhibition purposes has been applied for, and Thursday, October 9, has been set apart as exhibitors' day. No session of the association will be held, so that all may have time to examine the exhibits. The headquarters of the association will be at the Cadillac Hotel, the annual dinner being served at this house on Friday evening, October 10, when the officers-elect will be installed. The following resolution has been unanimously adopted by the executive committee: "The secretary is directed to request the chief executive officer of the different companies to notify all delegates and heads of departments attending the convention that they are expected to be present at all sessions of the meeting and take part in the discussions." The Detroit friends of the association are very anxious to have a large delegation of both members and ladies present, and a pleasing series of entertainments is expected. The passenger associations have granted rates of one fare and one-third for the round trip. Other hotels are the Russell, Wayne, St. Clair, Normandie, Griswold and Metropole.

A German contemporary describes a new galvanic cell which "inhales" the oxygen of the air. The cell contains in a saturated ammonium chloride solution a zinc rod and a porous pot provided with a semi-porous membrane. Within the porous vessel is placed a retort carbon, and the vessel contains a special depolarizing liquid. This depolarizing liquid constitutes a sort of a chemical sponge, which, when in the air, absorbs the oxygen thereof and gives it off again in the process of depolarization. The depolarizer consists of ammonium cuprate.

Balata Gum in Brazil.

Consul K. K. Kenneday, writing from Para, Brazil, states that the attention of interested parties in the United States has recently been attracted to the possibility of the balata fields on the Amazon. James A. Bouty, for many years a gutta-percha operator in the Guianas, on a trip of investigation through this region about one year ago, found the balata tree growing in abundance near Para, and on the Amazon and its tributaries for thousands of miles. The Brazilians had no knowledge of its gum-producing qualities. After persistent effort, Mr. Bouty succeeded in interesting parties in the United States and Para, bought a concession, and has lately begun the practical work of producing gutta-percha for the market. Sufficient time has not yet elapsed to demonstrate the commercial value of Mr. Bouty's personal experiment, but his work has served to open up a new industry for Brazil, which may develop into large proportions. As in the case of rubber, there is practically no limit to the supply of gutta-percha on the Amazon, and, as it can be produced at a fraction of the cost of rubber, it offers a much higher percentage of profit.

A report is given below on this subject from Mr. William Gerdeau, who has had a practical experience of many years in the Guianas, where he represented American and English gutta-percha importers and managed balata estates:

"Pursuant to your request, I submit the following report of my personal investigations of the balata fields of Brazil during my recent explorations of this region:

"The balata, or bulle tree (*Minsaps balata*), known in the Brazilian language as the macaranduba, grows in great abundance throughout the Amazon Valley, but up to this time no attempt has ever been made to introduce the gutta-percha trade in this country.

"For more than thirty years this trade has been carried on with immensely profitable results in the Guianas and the Orinoco Valley, but those fields are now almost exhausted, and very little gutta-percha has recently been shipped.

"It is my opinion that this balata trade can be made to rival the rubber trade in this country, as it can be produced here in unlimited quantities and its quality is, if not better, at least as good as the Guiana balata.

"I have found the balata trees scattered and in groves, sometimes amounting to forests many miles in extent, all over the states of Para and Amazonas, and I am informed on trustworthy authority that vast areas of these trees are growing on the Purus and Acre rivers and other tributaries of the Upper Amazon River.

"The method of bleeding the balata tree is entirely different from that used to extract the gum of the rubber tree, and only experienced and expert bleeders can be employed. But, on the other hand, these trees yield many times as much sap as the rubber trees, and one man can easily produce as many kilogrammes of gutta-percha in a day as twenty men can extract of rubber. These trees will average three and one-half pounds of gutta-percha each, and a competent bleeder can prepare forty to fifty pounds per day. The gum is first fermented and then dried in the sun, after which it is ready for shipment.

"I am surprised to find that this valuable gum, which is so easy of access and so cheaply prepared for market, has never become known to the trade here. Many great fortunes have been made in Guiana from this trade, and I believe the time is now ripe for American capital to develop the trade here. I found the Brazilians cutting down these valuable trees for firewood and building material, being ignorant of their true properties.

"Concessions of balata fields of any extent can readily be secured from the Brazilian Government, and private balata lands can be purchased for a fair price. It only requires some capital and practical knowledge of the business to develop one of the greatest industries in Brazil."

Book Review.

"The Bay Counties' Transmission." George P. Low. San Francisco. *The Journal of Electricity, Power and Gas.* Cloth. 80 pages. 11 by 14 inches. Numerous illustrations. Supplied by the ELECTRICAL REVIEW at $5.00.

This portfolio is a reproduction of a collection of articles of a popular nature, which have appeared in the *Journal of Electricity, Power and Gas* from time to time, upon the electrical power transmission systems of the Bay Counties' Power Company, of San Francisco, Cal. It is the aim of the author in presenting this reprint to commemorate the energy and judgment of the builders of the Bay Counties' system, which has given to California one of the most extraordinary engineering triumphs of America, if not of the world. The book is splendidly printed on fine paper, and the illustrations are numerous and very handsomely worked. It is well worth perusal, and will make a very desirable addition to the library of every engineer.

CURRENT ELECTRICAL NEWS

COMMERCIAL NEWS

DOMESTIC AND EXPORT

ELECTRIC TRACTION SYSTEM FOR WALES—Some $1,750,000 is to be expended in the construction of an electric traction system in the Rhondda Valley, Wales. For the building of the road, $850,000 has been allotted. The power plant and equipment will represent an estimated expenditure of $650,000.

WIRES TO NOME IN FIVE MONTHS—It has been announced that the line up the Tanana will be finished and telegraphic communication will be in effect between Seattle and Nome by March 1 next. The Valdes-Eagle line will be in operation the entire 400 miles across central Alaska by the first of September. In this way, the Copper River Valley will be connected by wire with the outside world during the coming winter. Instructions for the repair of the Juneau-Skagway cable have been given, and this break will be mended without delay. It is expected that by the time the line up the Tanana is completed that the wireless system to be established between Nome and St. Michael will be completed.

ELECTRIC LIGHT MERGER IN CALIFORNIA—Plans are under way for the reorganization of the Edison Electric Light Company of Los Angeles, Cal., in order to increase the corporation's capital stock to $10,000,000, to be divided into $4,000,000 preferred and $6,000,000 common stock. The preferred stock will be five per cent cumulative. The reorganization plan contemplates the exchange of securities in the present company for an equal amount of securities of the new preferred stock, with twenty per cent of the now common stock added, merging the present Edison company with the Redlands Light and Power Company, Santa Ana Gas and Electric Company, Pasadena Electric Company and other corporations. New funds will be used for the construction of a 20,000-horse-power electric water plant on Kern River, with transmission lines to and from Los Angeles, erection of a steam plant in Los Angeles for reserve purposes, and smaller plants on Mill Creek and Santa Ana River.

NEW YORK TO PHILADELPHIA BY TROLLEY LINE—The Union Trust Company, of Baltimore, has completed arrangements for an interurban trolley line to fill up a link in the long-distance trolley railroad planned between New York and Philadelphia. It is understood that the project covers an issue of $600,000 of first mortgage five per cent bonds of the Philadelphia, Bristol & Trenton Electric Railway Company. This bond issue acquires a trolley line partially built and will complete it. The line will run from Torresdale, a suburb of Philadelphia, *via* Bristol to Trenton, N. J., a distance of twenty-two miles. It is now in operation to Bristol and will be completed and be ready for operation December 1. The line runs through the manufacturing belt along the Pennsylvania Railroad between Torresdale and Trenton, and touches a number of small towns. The company will have a capital stock of $1,000,000, and an authorized bond issue of $1,000,000. Of the latter, $400,000 will be reserved for future requirements.

MORE BOSTON ELEVATED STOCK—Permission has been granted to the Boston Elevated Railway Company by the Board of Railroad Commissioners to issue additional stock to the amount of $3,300,000, the board fixing the value of the shares at $155 each. It is estimated that $806,500 shall be applied to the payment of the necessary cost of construction and equipment of the elevated structure, including foundations, tracks and electric system; $296,800 shall be applied to the payment of the necessary cost of construction and equipment of power stations; $471,000 shall be applied to the payment of the necessary cost of construction and equipment of terminal and other stations, exclusive of land; $69,700 shall be applied to the payment of the necessary cost of equipment of subways; $580,600 shall be applied for rolling stock and the equipment of same; $161,300 shall be applied for engineering and miscellaneous expenses; $862,500 shall be applied for real estate and for the payment of damages caused by the construction of the railway; $51,600 shall be applied for machinery, tools and miscellaneous equipment. Any surplus and proceeds of the stock over and above the amount actually required to provide for the above payments as specifically named shall be held subject to the further order of the board.

TELEPHONE AND TELEGRAPH

READING, PA.—The United Telephone Company has purchased the Lykens Valley Company's lines, giving them circuits through many parts of Schuylkill and Dauphin counties.

HILTON, N. Y.—Work has been begun setting the poles for a telephone line in this town, and it is said that the exchange will be in operation shortly. Mr. J. E. Cooper is at the head of the organization.

PHELPS, N. Y.—Representatives of the Interocean Telephone Company are said to be trying to secure the right of way through this section. The route as laid out runs from Geneva to Phelps past the Lehigh station and west to Clifton Springs.

WASHINGTON, D. C.—Work is to be pushed on a new telephone line from Fredericksburg, Va., to Tappahannock, which will give Washington communication with all of tidewater Virginia by way of Fredericksburg. It is expected that the new line will be completed and ready for operation in October.

COLORADO SPRINGS, COL.—The Western Union Company has decided to begin extensive improvements in its telephone and telegraph lines to the summit of Pike's Peak. As soon as the necessary equipment can be secured, a three-quarter inch cable will be installed from Windy Point to the summit, at a probable cost of $1,000.

PITTSFIELD, MASS.—The city council has adopted the ordinance controlling underground conduits in this city, and the aldermen have passed the permits giving the New England Telephone Company the privilege of building conduits in the city and the same to the Berkshire Telephone Company, the latter gaining the right to establish an exchange and do business in Pittsfield.

ALBANY, N. Y.—The Charlotte Valley Telephone Company has been incorporated with a capital of $650, to operate a telephone line in South Worcester, Otsego County; Summit, Charlotteville and Lutherville, Schoharie County. The directors are: George Oliver, Maleatus Bruce, Richard Jeffers, Leslie D. Smith, Levi M. Stevens, Hiram D. Haver, William Crapser, Peleg S. Taber, Nicholas Van Patten, of Charlotteville, and Arthur Heller, of South Worcester.

JACKSONVILLE, FLA.—Applications for letters patent will be made on October 1 by the incorporators of the Southern States Telephone and Telegraph Company, with headquarters at Jacksonville. The purpose of the company, as shown by the announcement made in advance, is to build and operate telephone and telegraph lines in the state of Florida. It is stated that the company will build lines from Jacksonville to Fernandina, to Pensacola, to Miami and Punta Rassa, with many stations intervening.

RICHMOND, VA.—The absorption of the Winchester Telephone Company by the United Telephone and Telegraph Company, of Philadelphia, has been announced. The new company controls 30,000 telephones, and will acquire 30,000 more. It is its intention to enter New York. The officers of the new company are: President, R. T. Barton, of Winchester; vice-president, W. D. Bernard, of Philadelphia; treasurer, S. R. Caldwell, of Philadelphia; local manager, S. L. Hoover; general manager, W. J. Latta, Philadelphia. The directors are as follows: T. J. O'Neill, Hanover; C. M. Clement, Sunbury, and S. H. Hansbrough and W. H. Baker, Winchester.

LEGAL NOTE

RIGHT NOT IMPAIRED—The right granted to a corporation by a municipal ordinance to construct and maintain an electric light plant, even assuming such right was exclusive, is held, in Capital City Light & F. Company *vs.* Tallahassee, advance sheets U. S. p. 866, not to be impaired by Fla. laws, chap. 4600, or Fla. act May 27, 1899, empowering the city to construct and maintain its own electric light plant, where nothing had been done by the grantee looking toward the erection and operation of such a plant, although it had erected and operated the gas plant which it was authorized by the same ordinance to construct and maintain.

ELECTRIC RAILWAYS

APOLLO, PA.—The Fairchance division of the Pittsburg, McKeesport & Connellsville Railway has been placed in operation.

HUDSON, N. Y.—A trolley road is projected from the long dock at Saugerties to Palenville, Greene County. The distance is fifteen miles and it is said that the contract has been let.

MANHEIM, PA.—The Lancaster & York Furnace Street Railway Company has been chartered, with a capital of $325,000, to build a trolley line from Millersburg to York Furnace, on the Susquehanna.

CLEVELAND, OHIO—It is stated that a company is to be incorporated for the purpose of constructing an electric railway from Cleveland to New Baltimore, which will connect with a new road being projected from Akron to Alliance.

CLEVELAND, OHIO—Improvements that will cost about $100,000 have been started on the Cleveland & Eastern trolley line. All the abrupt curves are to be straightened and the numerous heavy grades reduced. The work will require about a year's time.

SUPERIOR, WIS.—The Superior Suburban Railroad Company has been organized for the purpose of building a network of about 100 miles of electric road throughout Douglas County. The incorporators of the new company are: John Bardon, W. H. Webb, Henry S. Butler, W. J. Leader, Grafton Mason.

EVANSVILLE, IND.—It is stated that a movement is on foot to build an electric railway from Bowling Green to Hopkinsville, *via* Franklin, Russellville and Elkton. The object of the road would be to connect with the Illinois Central. If proper encouragement is received along the proposed route the road will be built immediately.

MT. JOY, PA.—The Florin & Elizabethtown Railway Company has been granted a charter. The applicants were: William B. Given, Columbia; Dr. H. K. Blough, H. C. Lewis and H. H. Nissley, of Elizabethtown, and I. R. Herr, of Lancaster. The road will be five miles long, and is intended to be a continuation of the Lancaster & Mount Joy line.

LITTLE ROCK, ARK.—The Fort Smith Suburban Railway has been granted a charter, with a capital stock of $100,000. The road will be six miles in length, running entirely around the city of Fort Smith. The directors of the company are: George Sengel, president; Frank Parke, vice-president; S. A. Williams, secretary; Ed Sengel, treasurer.

HARTFORD, KY.—The Hartford & Beaver Dam Electric Railway Company has filed an amendment to its articles of incorporation, changing its name to the Rough River Valley Railroad Company, in order that the road may be operated by either steam or electricity. It is expected that the road will be under construction by September 1. When completed it will connect this city with the main line of the Illinois Central.

NEW INCORPORATIONS

ADEL, IOWA—The Linden & Adel Telephone Company. $6,000.

ALBANY, N. Y.—Charlotte Valley Telephone Company. $650.

SHARON, PA.—The Sharon & West Middlesex Railroad Company. $50,000.

DES MOINES, IOWA—The Mingo Farmers' Mutual Telephone Company. $5,000.

TRENTON, N. J.—Pan-American Electric Light and Power Company. $1,000,000.

GREENVILLE, TEX.—The Greenville Telephone Company. Increased from $25,000 to $35,000.

CHICAGO, ILL.—The Automobile Electric Company. Increased from $2,000,000 to $3,000,000.

DENVER, COL.—The Delta Electric Light Company. $10,000. Incorporators: E. D. Blodgett, M. A. Shue and J. E. Shue.

AUSTIN, TEX.—The Whitewright Telephone Company. $10,000. Incorporators: W. C. Fain, R. May and Little Selph.

TRENTON, N. J.—The Adams Electric Company. $50,000. Incorporators: Carl F. Adams, Nicholas Jahn, S. Edgar Aller.

OSHKOSH, WIS.—The Winnebago Telephone Company. $150,000. Incorporators: A. B. Ferdinand, Walter L. Gold and Kate Kershaw.

NEW YORK, N. Y.—The James H. Mason Company. $50,000. Directors: E. A. S. Barkelew, J. H. Mason and J. W. Noble, of New York

WEST POINT, NEB.—The Bancroft Independent Telephone Company. $15,000. Incorporators: W. H. Watson, F. T. Rice, W. F. Sinclair and E. H. Morgan.

ROCKVILLE, MD.—Kensington Railway Company. $25,000. Incorporators: B. H. Warner, W. M. Terrell, J. W. Townsend, Charles W. Prettyman and Walter A. Johnston.

LOS ANGELES, CAL.—Ludlow & Southern Railway Company. $25,000. Directors: E. H. Stagg, of Johannesburg; Charles Weir, C. F. Smith, L. I. Davis and Walter Rose, of Los Angeles.

PIERRE, S. DAK.—Whitney Electrical and Development Company. $56,000,000. Incorporators: Loring L. Smith and George R. Martin, Chicago, and L. L. Stephens, South Dakota.

TEXARKANA, TEX.—Texarkana Traction Company. $100,000. Incorporators: J. S. Trittle, M. C. Wade and R. W. Rodgers, of Texarkana; T. W. Crouch and E. D. Spencer, of St. Louis.

DANSVILLE, N. Y.—The Mill Creek Electric Light and Power Company. $200,000. Directors: F. A. Owen, J. E. Crisfield, W. J. Beecher, D. C. Kreidler, F. J. McNeil, J. H. Baker and B. G. Foss.

DUNDEE, WIS.—The Dundee Water Power and Electric Light Company. $25,000. Incorporators: Leo C. Arimond, of Dundee; A. E. Richter, of Fond du Lac, and Mary Arimond, of Campbellsport.

CHICAGO, ILL.—Chicago, Milwaukee Avenue & Inland Lakes Traction Company. $50,000. Directors: George Leininger, O. A. Lewis, Louis Kaminsky, A. J. Wittman and Gideon F. Lanagher.

CAMDEN, N. J.—Atlantic & Chelsea Passing and Railway Company. $250,000. Incorporators: Louis Kuehule, Lewis P. Scott, Henry J. Rumerville, William B. Schofield, Kane S. Green, John M. Harding and Max Riebenack.

MERCER, PA.—The Sharon & West Middlesex Electric Railroad Company. $50,000. Incorporators: M. A. Norris and R. Montgomery, of Youngstown; Alfred N. Perkins, W. Williams and Mayor William McIntyre, of Sharon.

CINCINNATI, OHIO—The Cincinnati, Milford & Eastern Traction Company. $10,000. Incorporators: Sumner B. Day, George H. Chamberlain, J. B. Irven, J. B. Wallace, William R. Medaris and Senator Roudebush, of Clermont County.

INDIANAPOLIS, IND.—The Fort Wayne Electric Light and Power Company. $500,000. Directors: Edward R. Coffin, W. R. Bonbright, H. C. Paul, J. W. White, H. J. Miller, J. H. Bass, S. B. Fleming, J. B. McKim and F. S. Hunting.

MASSENA, N. Y.—The St. Lawrence River Power Company. $7,000,000. Directors: Henry P. Davidson, Englewood, N. J.; Mark T. Cox, East Orange, N. J.; Samuel E. Potter; William J. Wilson, New York, and Thomas A. Gillespie, Massena.

ALBANY, N. Y.—The Vermont & Whitehall Railway Company. $500,000. Directors: Daniel A. Slattery, J. Osgood Nichols, Kinsley C. Morehouse, Paul M. Mowrey, Ezra A. Tuttle, Leroy W. Baldwin, Harry M. Gough, Clinton E. Blaine and Ronald K. Brown, of New York.

SANTA FE, N. MEX.—The Tucumcari Electric Light and Water Company. $10,000. Incorporators: Alexander D. Goldenberg, J. A. Street, C. H. Rankin, Jacob Wertheim T. W. Heman. Officers: C. H. Rankin, president; J. A. Street, vice-president; T. W. Heman, secretary; Jacob Wertheim, treasurer.

ST. LOUIS, MO.—Neighborhood Light, Power and Heating Company; $50,000; incorporators: August Schlafy, of Alton, Ill.; P. French, J. L. La Prelle, Claude Kilpatrick, Isaac T. Cook and Thomas Wright. Sligo & Eastern Railroad Company; $120,000; incorporators: Joseph P. White, Rolla Wells, Edward F. Goltra, J. B. Dana and A. B. Shepley.

SOUTH BETHLEHEM, PA.—Souderton, Skippack & Fairview Electric Railway Company. $100,000. Officers: President, E. S. Moser, of Collegeville; vice-president, H. W. Reiff, Lederachville; secretary, B. W. Dambly, Skippack; treasurer, William S. Andrews, Fairview village. Directors: A. G. Reiff, M. C. Clemens, A. C. Alder, Dr. J. N. Hunsberger, J. R. Cassel, William A. Schultz, Dr. George K. Meschter and D. M. Anders.

ELECTRICAL SECURITIES

Although not so prominent as a week ago, the bullish sentiment still prevails throughout the stock market. While disappointment is being felt by speculators at the failure of important developments following immediately the return to this country of a number of the foremost financiers, the conditions are all that could be expected. The monetary situation has shown general improvement during the week, although it still holds its position as one of the prime speculative factors. Rates have held steady, with the bulk of call loans at 4 and 4½ per cent for the week. Next to the monetary situation and the prospects of a comparatively early termination of the coal strike, the crop outlook is engaging the attention of speculators. Conflicting rumors have stated that the harvest would not be so successful as previously expected, but the crop is in such a mature condition at present that it is not expected that even most unfavorable weather conditions could hurt it to any material extent.

ELECTRICAL SECURITIES FOR WEEK ENDING AUGUST 23.

New York:	Closing.
Brooklyn R. T.	66¾
Con. Gas	223⅜
Gen. Elec	187
Kings Co. Elec	202
Man. El.	134¾
Met. St. Ry	147
N. Y. & N. J. Tel. Co.	175
Westinghouse Mfg. Co.	220
Am. Union Electric Co.	13¾
Boston:	Closing.
Am. Telep. & Tel.	173
Edison Elec	280
Mass. Elec. pf.	97
New England Tel.	141
Western Telephone & Telegraph	101
Philadelphia:	Closing.
Elec. Co. of America	9
Elec. Stor. Bat. c	89½
Elec. Stor. Bat. pf.	89½
Philadelphia Elec.	6¼
Union Traction	48
United G. I. Co.	112¾
Chicago:	Closing.
Chicago Edison Light	175
Chicago Telep.	171
Metropolitan El. pf.	89¼
National Carbon	31½
National Carbon pf.	99
Union Traction	16¼
Union Traction pf.	48

OBITUARY NOTICE

MR. GEORGE M. HOPKINS died in Chester, Mass., on Saturday, August 16. Mr. Hopkins was a resident of Brooklyn, living at 325 McDonough street. He was prominent as a patent attorney and conspicuous in scientific research work, being the author of "Experimental Science," a book which has been very largely used in technical schools. As one of the editors of the *Scientific American*, he had charge of the electricity department, and also conducted the department of "Questions and Answers." Mr. Hopkins is survived by a widow and son.

ELECTRIC LIGHTING

RICHMOND, IND.—The city council, by unanimous vote, has accepted the municipal light plant built by the Varley Construction Company, of Indianapolis.

HARRISBURG, PA.—It is stated that the Paxang Electric Company will build a $400,000 power plant in this city. It is hoped to have part of the plant ready for operation by December.

LOS ANGELES, CAL.—Construction is now under way on the Pacific Light and Power Company's plant, and it is expected that within twelve months the corporation will be in operation. The line will extend from Kernville southwest, and will cost about $200,000.

OMAHA, NEB.—Permission has been granted the New Omaha Thomson-Houston Electric Light Company to use certain streets of the city for the construction of underground conduits, in which the company is to place wires for the transmission of electricity. The work will involve an outlay of $200,000.

READING, PA.—The Farmers' Mutual Railway Company has been organized, to build an electric railroad from Ephrata to Lincoln. It is the intention of the company to extend the road to Myerstown, Lebanon County, a distance of eighteen miles, and connecting at that point with the line running to Lebanon.

JAMESTOWN, N. Y.—The Jamestown Electric Light and Power Company's plant has been sold at mortgage foreclosure. The sale included all of the company's property, real estate, franchises, equipment, etc. William H. Whitney, of Boston, was the purchaser, and the price paid was $10,000, only one bid being received.

LOUISVILLE, KY.—The plant of the Jeffersonville Light and Water Company has passed into the hands of Edward Burnett Smith, of Chicago, an attorney in the employ of the United Gas and Electric Company. The price paid was $70,000. The newly acquired plant will be merged with the electric light, gas-heating and coke company.

CHARLOTTE, MICH.—The Grand River Electric Company has been organized for the purpose of furnishing Lansing with electric power from Delta, where the company will build a dam and generate electricity for lighting, heat, etc. The company is capitalized at $50,000 and has secured about 200 acres of land along the banks of the Grand River near Delta. Construction will be begun shortly.

NEW YORK, N. Y.—The Union Railway, Power and Electric Company, the Morris Electric Company, Fountain Manufacturing Company, and five other established railway equipment and electrical companies, have been consolidated under the name of the American Union Electric Company, with a capital of $7,000,000. The management of the company is under the direction of Elmer Morris, S. M. Young, E. P. Ewing and J. Fountain.

COLUMBUS, GA.—A deal has been closed by which the Stone & Weber Syndicate, of Boston, who are now the owners of the street railway lines of this city, come into possession of all the river front property on the Georgia side of the Chattahoochee River from the property of the Columbus Power Company, just above the city, to the mouth of the Standing Boy Creek, a distance of about eight miles. It is stated that the company will build a dam across the river forty-seven feet high and will erect a power plant which will have a minimum of 16,000 and a maximum of 20,000 horse-power, and that the power generated will be used to operate the street car lines in the city, as well as the street lights and other industries.

PERSONAL MENTION

MR. KEMPSTER B. MILLER, the telephone engineer of Chicago, and Mr. W. W. Dean, are spending some weeks hunting big game in Colorado.

MR. FRANK B. KNIGHT, Dallas, Tex., special agent of the American Bell Telephone Company, is visiting New York and Boston, and renewing many old friendships.

PROFESSOR R. S. HUTTON, Owen's College, Manchester, England, has arrived in the United States, and during his stay will inspect the principal electrochemical college laboratories and manufacturing works of the country.

MR. WILLIAM F. ZIMMERMAN, vice-president and general manager of the St. Lawrence Power Company, has resigned, to take effect September 1. Mr. Zimmerman will probably spend a few months in rest and recreation abroad before entering the electrical field again.

DR. ALLAN V. GARRATT, chief engineer of the Lombard Governor Company, Boston, was a New York visitor last week. Dr. Garratt reports that his company is rushed with business and the demand for its new catalogues would indicate a growing field for the company's product.

MR. GEORGE H. DANIELS, general passenger agent of the New York Central & Hudson River Railroad, delivered a striking address, as a part of the regular course, before the Chautauqua Assembly, at Chautauqua, N. Y., August 11, on "American Railroads and Our Commercial Development."

MR. M. H. BENTLEY, chief engineer of the International Telephone Manufacturing Company, Chicago, Ill., has just returned from an extended trip through England and the principal countries of Europe, where he has been studying the telephone field and the possibilities of supplying equipment from this country.

MR. ARTHUR D. NEWTON, Hartford, Ct., secretary and treasurer of the Electric Vehicle Company, was a New York visitor last week. Mr. Newton has recently associated himself with this company and his extensive circle of electrical friends will all extend a cordial greeting to him in this comparatively new and rapidly growing field.

INDUSTRIAL ITEMS

THE GUARANTY ELECTRIC COMPANY, Chicago, is just taking 24,000 feet of additional space which this company will occupy entirely from the first of September.

THE AMERICAN INSULATED WIRE COMPANY, 241 and 247 South Jefferson street, Chicago, has found it necessary, owing to the greatly increased business, to take another floor in the establishment at that address, exactly doubling its former capacity.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY has removed its district office from the Sun Building, Washington, D. C., to the Continental Trust Building, Baltimore, Md.; this move being made necessary by the large amount of business which the Westinghouse company transacts in the city of Baltimore.

THE SUNBEAM INCANDESCENT LAMP COMPANY, Cleveland, Ohio, states that there is every indication that all records will be broken in the sale of its well-known lamp during the next few months, the factory product shows a steady improvement in quantity each month, and those who are not familiar with the Sunbeam lamp are invited to give it a trial.

MESSRS. KLEMM & COMPANY, Philadelphia, Pa., are the manufacturers of the patent Diamond diffuser reflectors, suitable for lighting churches, theatres, halls, etc. These are constructed upon scientific principles, and are claimed to increase the life fourfold. A comprehensive catalogue, illustrating and describing the line of manufacture produced by this company, will be sent on application.

THE FACTORY OF P. & F. CORBIN, New Britain, Ct., was destroyed by fire on August 8. The purchasing and sales department suffered the heaviest losses, many papers relating to orders being consumed, together with the entire collection of catalogues of the purchasing department of the American Hardware Corporation. Manufacturers are requested to send copies of their catalogues to the purchasing agent, Mr. A. N. Abbe, to replace those lost.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., is supplying the market with its multiple burning sign lamp, and a special illustrated circular is ready for any who may be interested. This lamp has been made to meet the demand in which the end candle-power is of the first importance, such as in sign work. This is furnished in four, six and eight candle-power, 45 to 130 volts, and is fitted with any standard base. The bases are porcelain insulated and attached with water-proof cement.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, Ill., has issued a handsomely illustrated catalogue describing its apparatus. This company has recently been awarded contracts by the independent telephone companies of Columbus and Dayton, Ohio, to equip the exchanges in those cities. Each exchange will have an ultimate capacity of 19,000 stations. The Columbus exchange will begin with 6,000 telephones connected up, while the initial installment for the Dayton exchange will be 7,000 stations.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., is sending out a postal card bearing an illustration of the Pennsylvania Building, Philadelphia, which shows this immense steel frame structure to great advantage. The structural steel work of this building was erected in twenty-seven working days. The inference is that Dixon's silica graphite paint permanently protects the steel frame from corrosion. The economy of protective painting will be explained upon request by this company.

THE INDUSTRIAL PRESS, New York, has ready the August edition of section "A" of the Mechanical Index, comprising a list of machine tools, metal-working machinery and accessories. The complete work is an encyclopaedia and list of manufacturers in the United States of mechanical appliances and tools operated by steam, electricity, water, air, hand or foot power. These departments are carefully arranged under subheadings for quick reference, and the index is aranged in English, German and Spanish.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, New York city, in order to facilitate the handling of a rapidly increasing business, has leased a four-story and basement building at 39 Dey street which, in connection with the present quarters, gives the company a floor space of over 25,000 square feet; the entire first floor of the new building has been arranged for offices, the rest of the building will be used for additional stock, thereby enabling the company to carry a much larger and more complete stock than heretofore.

THE REPLOGLE GOVERNOR WORKS, Akron, Ohio, have recently secured an order for a Spanish installation through the Pelton Water Wheel Company, of New York city, for five sectoidal relay governors and three duplex relay governors. The Rochester Gas and Electric Company, of Rochester, N. Y., has installed one differential relay governor. The Montreal Cotton Company, of Valleyfield, Quebec, has installed a relay returning governor, and the Shattuck & Babcock division of the American Writing Paper Company at De Pere, Wis., an electrical relay governor.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., section agent, states that the success of the Packard lamp in the last year has been more pronounced where the conditions have been unusually difficult than ever before, and believe that it shows that the factory is better prepared to furnish lamps where the specifications are such as to bring out the very finest points in incandescent lamp-making. Some of its very pronounced successes in the last year have been among the largest street railway companies in the world, where the contractors were placed upon severe competitive tests, and the lamps have not only furnished the requirements, but there has been an actual saving by two of the largest street railway companies in the world in lamp renewals, one of thirty-three and one-third per cent, another of twenty per cent over previous years, in one case with the same number of lamps and the other with an increase in the lamps in actual use of about eight per cent. The success in the street railway line has followed closely upon the success in the manufacture of lamps for commercial service, and is due largely to the policy of the company sticking to standard lamps and avoiding novelties.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, manufacturer of electric light and power machinery, has made the following recent contracts: The Krell French Piano Company, Newcastle, Ind., one 200-kilowatt, engine type, direct-connected generator, and 56 motors of sizes from 5 to 40 horse-power, aggregating 520 horse-power in motors; Wooster University, Wooster, Ohio, two 100-kilowatt and one 50-kilowatt, engine type, direct-connected generators; the Kanawha Valley Traction Company, Charleston, W. Va., two 125-kilowatt, belted type of generators; Eastern Kentucky Asylum for Insane, Lexington, Ky., one 75-kilowatt, engine type, direct-connected generator, and one 15 and one 10-horse-power motors; the United States Printing Company, Cincinnati, one 100-kilowatt, engine type, direct-connected generator; the Globe Wernicke Company, for its Cincinnati plant, one 200-kilowatt, belted generator and 15 motors, in sizes of 5 to 30 horse-power, aggregating 380 horse-power in motors, for the same company for its Norwood plant, one 200-kilowatt, engine type, direct-connected generator, and 12 motors of 5 to 65 horse-power capacity, aggregating 530 horse-power in motors; the Armour Packing Company for its New Orleans plant, one 75-kilowatt, engine type, direct-connected generator; the Water Works and Electric Light Company, Norwood, Ohio, two 100-kilowatt, engine type, direct-connected generators; the Kenmare Coal Company, Minneapolis, Minn., one 80-kilowatt, belted generator; E. H. Hewins, Boston, Mass., two 30-kilowatt, engine type, direct-connected generators; P. Derby & Company, Gardner, Mass., one 25-kilowatt, engine type, direct-connected generator; the John A. Dunn Company, Gardner, Mass., one 30-kilowatt, belted generator; Ralph S. Hopkins, Seattle, Wash., one 50-kilowatt, belted generator; Northern Pacific Railway Company in its St. Paul shops, one 50-kilowatt, engine type, direct-connected generator, and one 15 horse-power, one 7½ and one 10-horse-power motors; the Calvert Lithographing Company, Detroit, Mich., one 75-kilowatt, engine type, direct-connected generator; the Beals & Selkirk Company, Detroit, Mich., one 30-kilowatt, direct-connected generator; the Brady Union Stock Yards Company, Atlanta, Ga., one 30-kilowatt, engine type, direct-connected generator; the Eclipse Electric Company, St. Louis, Mo., one 25-kilowatt, engine type, direct-connected generator; the James H. Curran Elevator Company, Cincinnati, 21 elevator motors; F. Woodlar & Company, Cleveland, Ohio, one 25-kilowatt, belted generator; W. P. Callahan & Company, Dayton, Ohio, 15 lighting machines of 7½ to 10-kilowatt capacity; the Buckeye Iron and Brass Works, Dayton, Ohio, 12 machines of 7½, 10 and 12½-kilowatt capacity.